THE HEATING AND VENTILATING MAGAZINE

1123 BROADWAY NEW YORK AUGUST, 1905

Congress of German Heating and Ventilating Engineers

Hamburg, Germany, July 2-5, 1905
Translated for "The Heating and Ventilating Magazine"

Some 300 heating engineers met in convention in Hamburg, Germany, July 2-5, with representatives present from all parts of Germany and foreign countries, to discuss the subject of heating and ventilation and listen to papers by experts on the latest improvements and methods in developing the art.

At the formal opening of the convention Senator Dr. Traun made an address welcoming the members to Hamburg, and Professor Hartman took the chair as presiding officer of the convention.

The Future of the Heating and Ventilating Profession

The first paper presented was one by Prof. H. Rietschel, member of Government Board, on "The Future of the Heating and Ventilating Profession." He said, in part:

"Recent investigations by Professor Flügge-Breslau show emphatically that the regulation heat in rooms must be more carefully looked after than has been done heretofore. The researches of Professor Flügge have shown that overheating of rooms may have an effect on their occupants which can prove more harmful to their health, perhaps, than the deterioration of the air of the room to a certain degree. The temperature of a room in winter should not rise above 20° to 21° C. To people in health a temperature of 17° to 19° C., as a rule, is most beneficial. Regulation of the heat will be permanent or satisfactory only with apparatus working automatically. America is ahead of us in this respect, as more is expended there for heating and ventilating systems than is spent here, where, in so many cases, only the means for the essentials are provided.

"In this economy there is surely a great mistake. With limited means, a well-constructed stove is to be preferred to a central heating plant. It is the work of the expert engineer to fight every thing that permits the installation of such inadequate central heating plants or support their construction.

"Increasing importance will be given in future to heating at a distance. The heating engineer, also, must not content himself with providing the necessary amount of heat, but also devise means for obtaining the greatest efficiency from the fuel employed.

"From a central station, for example, heating gas will be conducted to separate heating groups to supply the place of solid fuel under the boilers of the separate heating apparatus. The better conductibility of gas on long distances and the possibility of a much more delicate regulation with regard to the heat generation under the separate boilers, are the advantages of heating by gas.

"Ventilating apparatus, in general, has not been perfected to the same extent as much of the heating apparatus now in use. Still less than heating has ventilation been worked out into a system. Particularly has the

so-called exhaust system of ventilation proved most ineffective, when used with a low outside temperature.

"The increasing possibilities for employing electricity for setting the air in motion will in great measure tend to the improvement of our ventilating systems. The delicacy of the apparatus for conducting the current permits of better arrangements also for automatically controlling the ventilators.

"In order to prevent an oversupply of air through a wasteful current, it will be necessary to examine the experiments hitherto made for determining the necessary quantity of air, and, more particularly, to allow for the natural air movement through the rooms. The allotment of a definite air space to each occupant of a room does not make up for not providing abundant provision for ventilation.

"Instead of this, windows to-day offer the only possibility of ventilation in many rooms. The building regulations should not rely upon the opening of windows, especially as stormy conditions limit the opening of windows and make necessary an additional method of ventilation.

"The ventilating systems provided should be constantly under inspection, so as to insure efficiency during the changes of the seasons and the uses made of the room.

"It might be a welcome task for the engineers in the government employ to assist the efforts of the heating profession to provide good ventilating plants. In the schools it must be pointed out how necessary fresh air is to the maintenance of good health.

"Provision for cooling residences in the hot periods of the year are almost entirely wanting. The appliances for this purpose are as yet altogether too expensive, but this sanitary improvement of dwellings will in time be provided for.

"This resolution of the 'German Central Heating Society' is highly appreciated, to apply to the government for the establishment of heating and ventilating chairs of instruction in the high schools.

"Everything must be done to discourage the practice of builders who limit, as far as possible, the cost of heating and ventilation installations. A firm stand by all interests must be made to overcome this evil, only in this way can this sordid competition be met.

"Through the press we have a good means of interesting the public in the value of good heating provisions, through the publication of articles by specialists. The more the intelligent layman is informed in this direction, the more will the demand for the installation of heating and ventilating appliances increase, so that the parsimonious competition will fall to the ground itself.

"By publicity the authorities will also be induced to give attention to this important matter."

A brief discussion of the paper followed, in which, among others, Mr. Henneberg, president of the German Industrial Central Heating Society, stated that the many valuable suggestions of the lecturer would receive due attention from the society.

Experiences in Firing Simple Stoves and Boilers

Mr. E. Niess, engineer-in-chief of the Union for Heating Management and Smoke Control in Hamburg, spoke then on "Experiences in Firing Simple Stoves and Boilers." The Union founded in October, 1902, he said, was formed in response to the public demand for the abatement of the often unbearable smoke nuisance. The Union also strives to perfect industrial heating, particularly heating by boilers. This object is pursued in two directions, by the improvement of the heating contrivances to secure better fuel economy and, by better instruction of the stoker, to bring about as completely as possible the combustion of the fuel.

To make the most out of the coal and to work it free or measurably free from smoke are not always attained, but both can surely be accomplished. There are cases, also, where in spite of considerable smoke discharge the best use of the coal is

obtained, and, on the other hand, with a chimney working entirely free of smoke only a comparatively small amount of the available heat in the coal can be utilized.

The loss in the combustion consists in the loss in the residuum, the loss through the heating pipes and radiation, loss by incomplete combustion, and, finally, loss in free heat that disappears unused with the surplus air brought in.

The speaker discussed the process of combustion, methods of fire management and admission of air, the essential conditions for a smokeless but economical practical heating apparatus.

The speaker also pointed out that a prohibition by-law of the exclusive use of smokeless fuel was not practical and could not be enforced. This fuel would, by its exclusive use, become still dearer than it is now.

Friction of Air in Long Pipes

The next speaker was Engineer Karl Brabbée, of Vienna, who spoke on "Investigations on the Friction of Air in Long Pipes." Carefully selected diagrams, tables and sketches were shown during the lecture, by means of which his hearers were enabled to follow the lecturer in his explanations. The lecture was received with applause, but, unfortunately, no report of it is furnished.

Ventilation of Theatres

At the second session on Wednesday Director Pfützner, of Dresden, read a paper on "The Ventilation of Theaters." He began with a historical glance over the endeavor and practical achievements of theater ventilation, and spoke of the systems which have been evolved from these. Among heating engineers, he said, there is almost entire unanimity that in theater ventilation the most important matter is the purity of the air in the reach of the audience; and, therefore, that the exhalations from the audience should be led off rapidly. There exists, he said, among ventilating engineers great difference of views as to whether ventilation should be obtained from above or from below. In 1869 ventilation from below upwards was first introduced in Vienna, and from that time this system has remained the prevailing one.

A danger that the dust in air movement from below will also move upward is avoided by leading the air not directly over the floor, but from the height of the seats. The heating of the air by the crowd in the theater, in the opinion of the speaker, is best attended to by the removal of the vitiated air upwards.

Of course, in every method of ventilation drafts must be avoided. The fact should also be taken into consideration that the constant body-heat developed in the theater is cooler than the air of the room. In ventilation from below the feet and legs of the auditors are first affected, and these are protected by the same covering worn on the street. In ventilation from above the upper part of the body is affected first, which, in the case of ladies, at least, is usually clothed only with light material, thus increasing their chances of taking cold.

In weighing the question of which is the best mode of theater ventilation the possibility of a fire starting on the stage must be taken into account. In the opinion of the speaker, which he endeavored to base on theoretical and practical grounds, ventilation from below upward has every advantage. In conclusion, the speaker gave observations that he himself as theatergoer had made.

During a four-hour representation in the Dresden theater, the temperature in the parquet rose from 16 to 21 degrees C.; in the upper tiers the temperature was from 1 to 1½ degrees higher. This favorable result was due to the ventilation from below upward. No complaints about drafts were heard.

In other theaters in South Germany with ventilation from above, the speaker could not note such good results. Both systems have their good and bad points, yet on the whole the greatest advantages remain with the upward system.

Lack of time prevented a long dis-

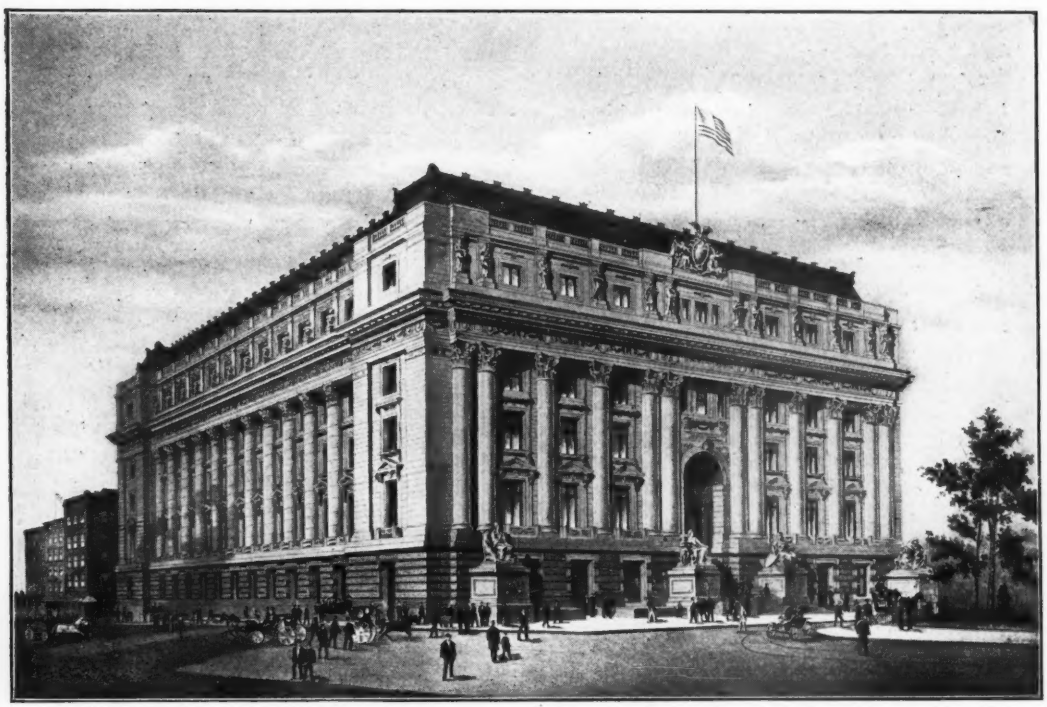
cussion of the subject in which the audience manifested the liveliest interest.

The last topic presented was "Modern Bathing Establishments with Special Regard to the Production of Artificial Waves."—From Zeitschrift fur Heizung, Lüftung und Beleuchtung.

Heating and Ventilating New York's New Custom House

A Notable Type of the Fan Pressure System

New York's new Custom House is one of the few large buildings in the East that will be heated practically throughout, as well as ventilated, by the fan pressure system. The only exception will be a corner of the building devoted to a sub-station of the Post Office, and direct radiation is installed here for the reason that the sub-station is to be open at night when the remaining parts of the heating system will be shut down.

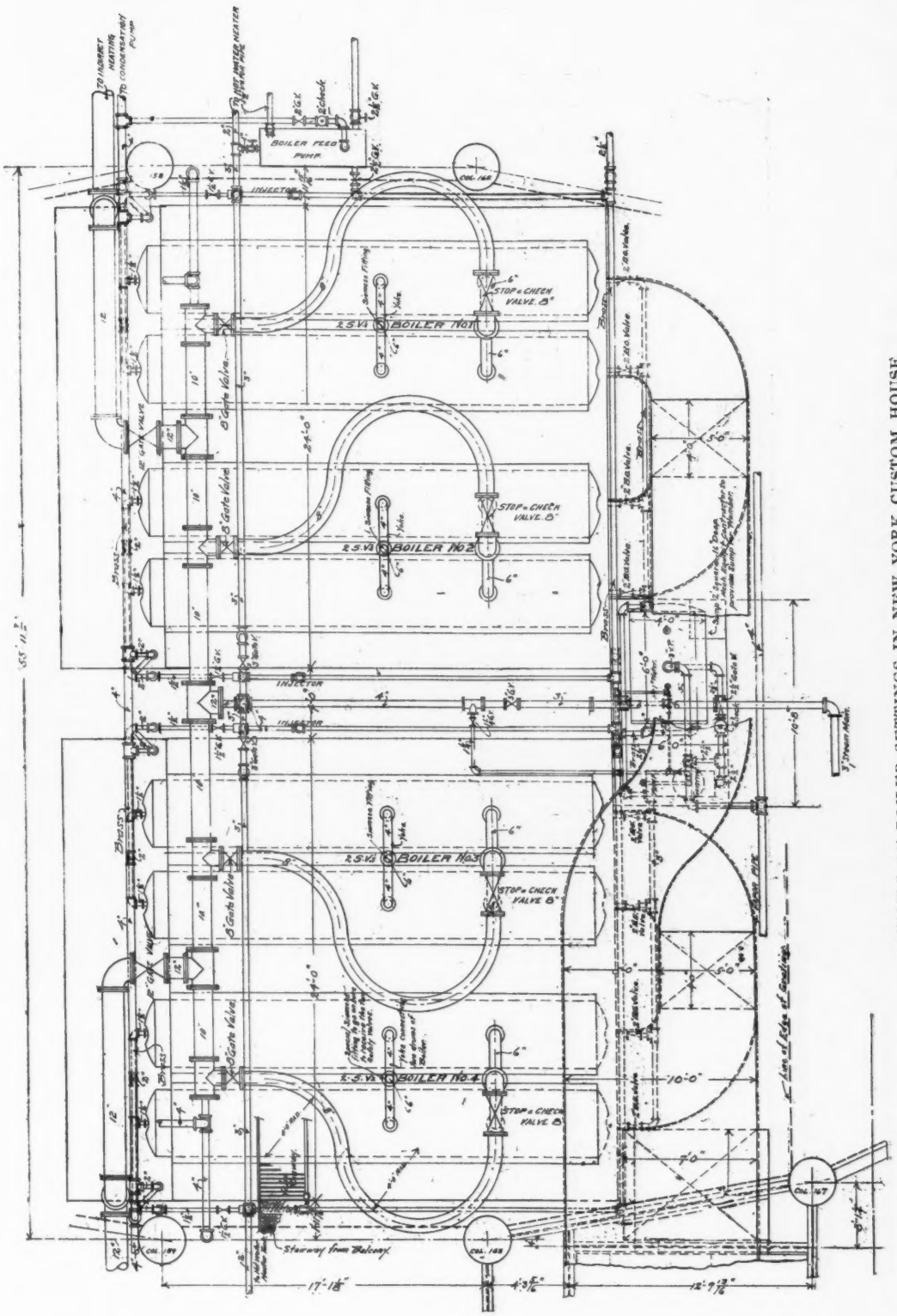


NEW BUILDING FOR THE UNITED STATES CUSTOM HOUSE IN NEW YORK

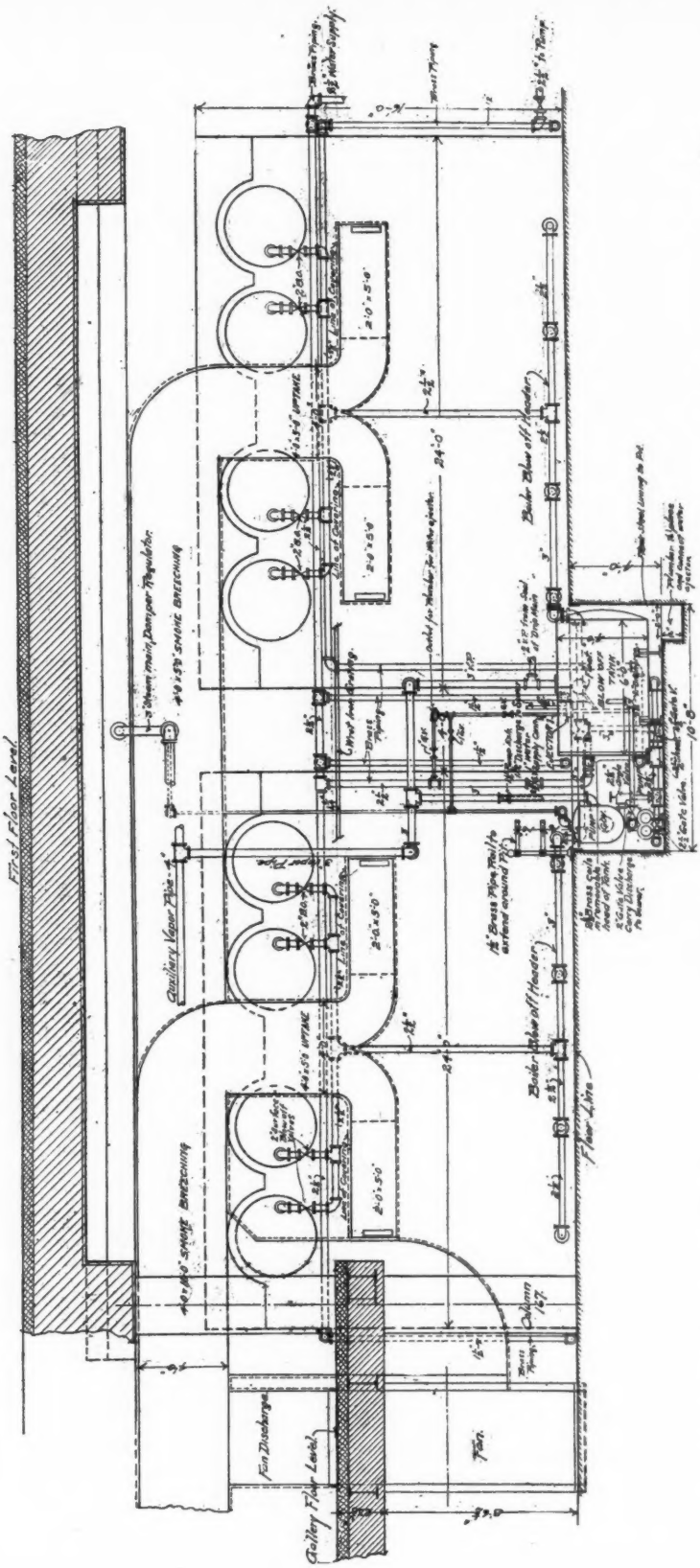
Although the plans call for the installation of high pressure boilers, the plant will be operated at low pressure for the present. It is the intention later to install generators and until that is done the electric power will be furnished by contract. Space, however, has been reserved for the generators, and the piping and boilers have been laid out accordingly.

There are four 300 H. P. water tube boilers of the horizontal sectional water tube, inclined header type, arranged to be set in two batteries of two boilers each, and capable of carrying an average working steam pressure of 125 pounds. The two individual smoke up-takes from each battery of boilers are brought together into the breechings. Each of these two breechings is united horizontally into a main smoke duct. The arrangement is fully shown in the accompanying illustrations.

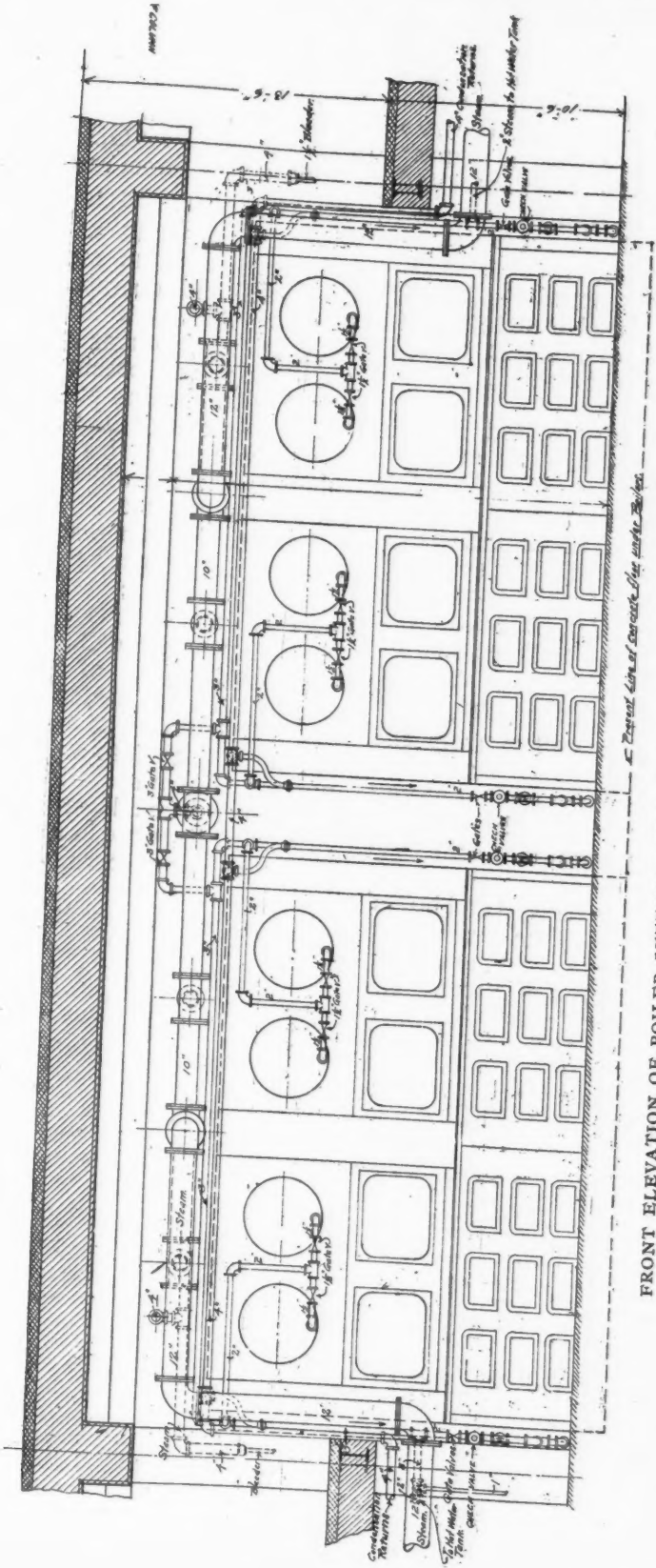
A mechanical draft fan is also provided and is so installed by means of by-pass connections with the smoke



DETAILS OF BOILER SETTINGS IN NEW YORK CUSTOM HOUSE



REAR ELEVATION OF BOILERS AMD BREECHING, NEW YORK CUSTOM HOUSE, SHOWING LOCATION OF INDUCED DRAFT FAN



FRONT ELEVATION OF BOILER SETTINGS, SHOWING MAIN AND AUXILIARY STEAM HEADERS

duct that it may be operated or not, as desired. The fan itself is of the full housed steel plate peripheral discharge type, operated by a medium speed, 225 volt, D. C. motor. The case is split vertically in such a manner that it may easily be taken apart and the fan wheel removed without disturbing the breeching. It has a capacity of 40,000 cubic feet of air at 70° F. per minute, at a speed of 200 r. p. m., and at that speed is designed to maintain a draft of not less than 1 inch water column at uptakes of boilers.

The boilers being located in the center of the sub-basement and the coal vaults being at one end of the building, it is necessary to install a 24-inch gauge coal railway and charging cars. The rails will consist of cast plates having slots for the flanges for the wheels in the place of rails. The cast plates are to be set in cement on the concrete floor construction.

HIGH PRESSURE STEAM PIPING

The two steam outlets from the two drums on each boiler are united by means of a cast iron yoke into an 8-inch outlet between the two, as shown in the illustration. An 8-inch 90° elbow is attached to the outlet and connected by a flanged and bolted stop and automatic check valve into an 8-inch wrought iron extension bend, having a radius of 4 feet. The four expansion bends are then connected into a 10-inch header through an 8-inch gate valve.

In the center of the header a T is provided with 12-inch opening for future connection, looking to the rear of the boilers, and near each end of the header a T is provided with a 12-inch outlet for the steam supply to the fan heater groups, having a 12-inch gate valve at each T. There are also additional outlets for the direct radiation mains.

From the 12-inch gate valves at each end of the boiler header 12-inch steam supply mains are carried to opposite sides of the building where they branch off with 7-inch connections to the main heater groups, of which there are four.

There is another system of piping leading from two spray circulation pumps to the spray chambers with returns. Each pump supplies two apparatus groups or 88 spray nozzles.

Still another system of piping connects with the Post Office sub-station, equipped with direct radiation.

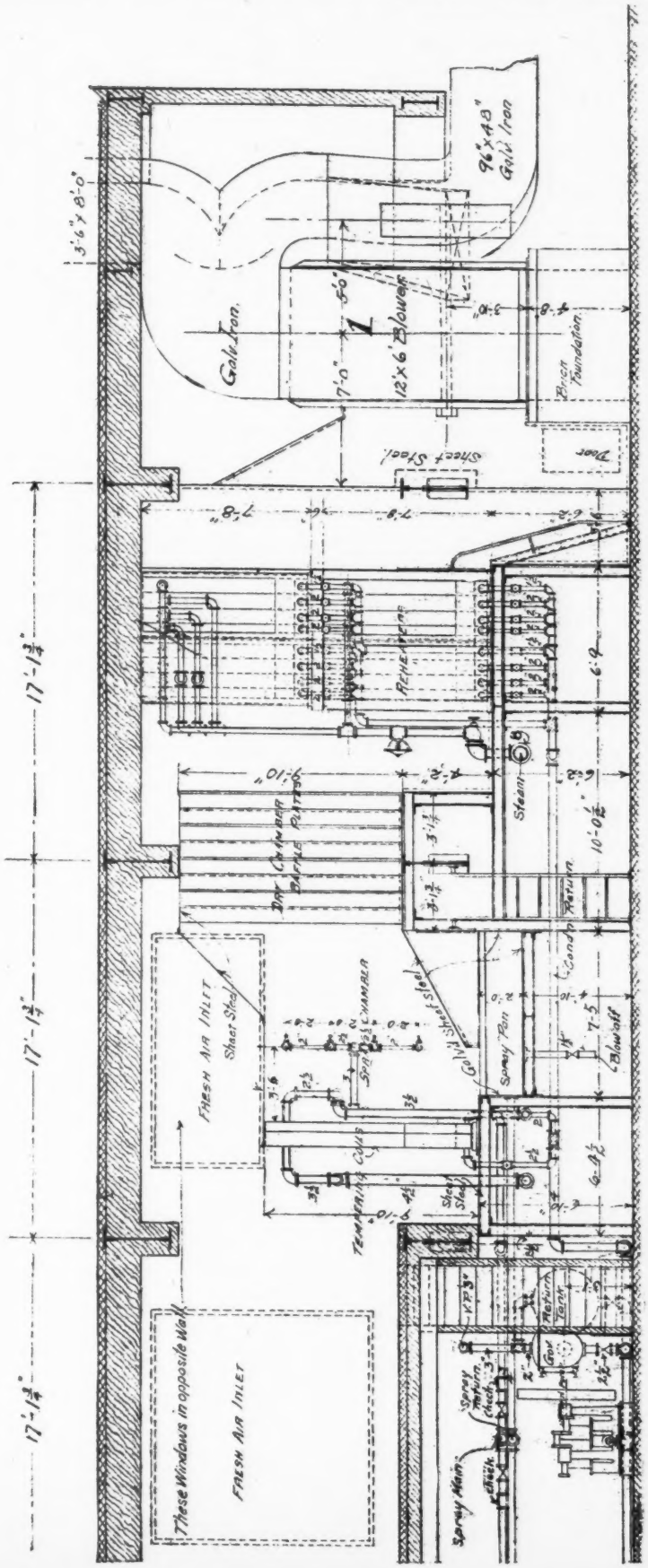
HEATING AND VENTILATING SYSTEM

The heating and ventilating system is divided into four main groups of apparatus and operated by electric motors. Although the Post Office sub-station at the rear of the building (occupying the basement and first story) is to have an auxiliary system of direct radiation, the main heating system will cover this portion of the building where it will be in operation during the daytime.

Each of the four main heating apparatus groups consists of a fresh air suction chamber; tempering coils with by-passes; air spraying apparatus for washing the dust from the air; a dry box system of vertical baffle plates; main re-heater coils, and a peripheral discharge blower delivering the hot air into the vertical galvanized iron air shafts, which have horizontal trunk lines at each floor. The trunk lines are in most cases carried down the corridors over false ceilings.

Thermostatic regulation is placed in the main rooms of the building controlling the temperature of those rooms by adjusting volume dampers behind the hot air inlet register faces in the rooms. In addition to this there is thermostatic regulation in the tempering coils, the re-heater coils and the by-passes to control the temperature of the hot air delivered to the system.

In other words, it is the intention to maintain a temperature which shall vary with the difference between the temperature within the room and that outdoors. This is considered necessary for the reason that, with an excessively high temperature in the hot air ducts, such as would be likely on a mild day, the thermostats in the various rooms might entirely close the inlet registers without materially reducing the temperature.



DETAILS OF INDIRECT HEATING APPARATUS, NEW YORK CUSTOM HOUSE. ELEVATION OF GROUP 1

The ventilation of the different offices is accomplished mainly by means of vent registers in the corridor doors, although, in some cases, there are short vent flues taking the air off from the floor and discharging it at a higher level into the corridors. In a few instances, there will be small vent registers in the window sashes. In each case there will be a register face in the rooms and another in the corridor whether the ventilation is accomplished through the door or through a short vent stack, and in each case, also, automatic ventilating dampers are placed between these two faces.

Ventilation from the corridors is accomplished by means of the elevator shafts and cylinder shafts in the rear of same, which connect with ventilating monitors on the roof, having automatic dampers. The object here is to prevent the working backward or stopping of the system due to wind pressure.

The toilet rooms have separate vent systems, with independent ventilating ducts from the different toilet rooms leading to the attic and connecting to toilet room vent fans, discharging through the roof.

LOCATION OF HOT AIR REGISTERS

For the most part the hot air register openings into offices and other private rooms are at a point between eight and twelve feet from the floor. Hot air register openings into the corridors or hallways are at the above heights or at the level of the floors, as required.

All ventilating registers from either offices, corridors or toilet rooms are located near the floor level, but in the toilet rooms additional registers are placed near the ceiling.

BLOWERS AND BLAST COILS

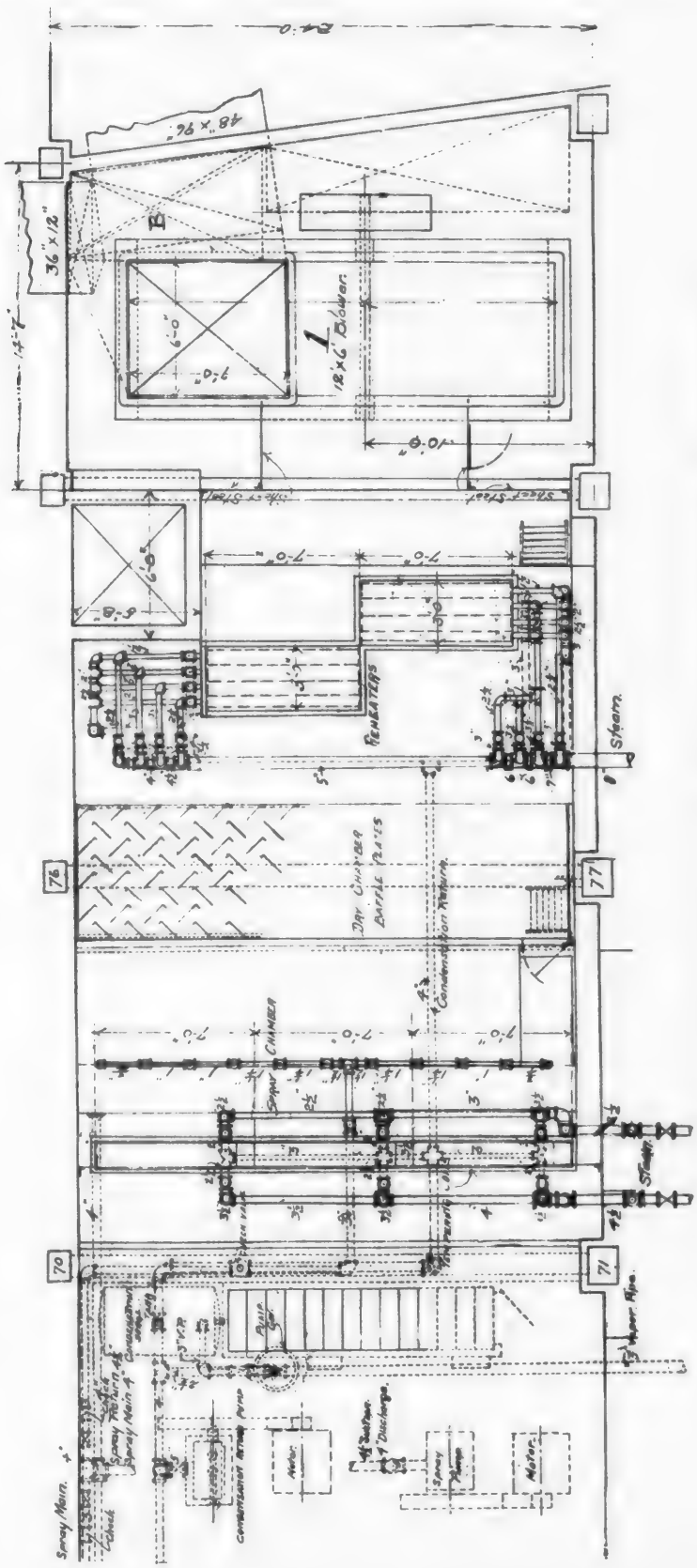
As already noted, the heating and ventilation is divided into four groups of apparatus. All of the fans are of the peripheral discharge, three-quarter housed, pulley type, with steel plates, having wheels 12 feet in diameter by 6 feet, width of case. Each fan has a capacity of 100,000 cu. ft. of air per minute when operating at a speed of 140 R. P. M. The operation of the fans is as follows: Fan No. 1, left hand up blast; No. 2, right hand up blast; No. 3, left hand bottom horizontal 45 degrees down; No. 4, right-hand bottom horizontal 45 degrees down. The fans are operated by four medium-speed 225-volt direct current motors, of the semi-enclosed type.

In the construction of the tempering coils and re-heater coils, each coil consists of a vertical cast iron, steam header and a horizontal condensation return base, having miter coils connecting the two. The pipes in each coil are placed staggered. The construction of both headers and bases is such that water of condensation cannot stand in either, and when the coils are drained or the pressure removed each section stands dry. The coils are to circulate 5 pounds steam pressure at the coils.

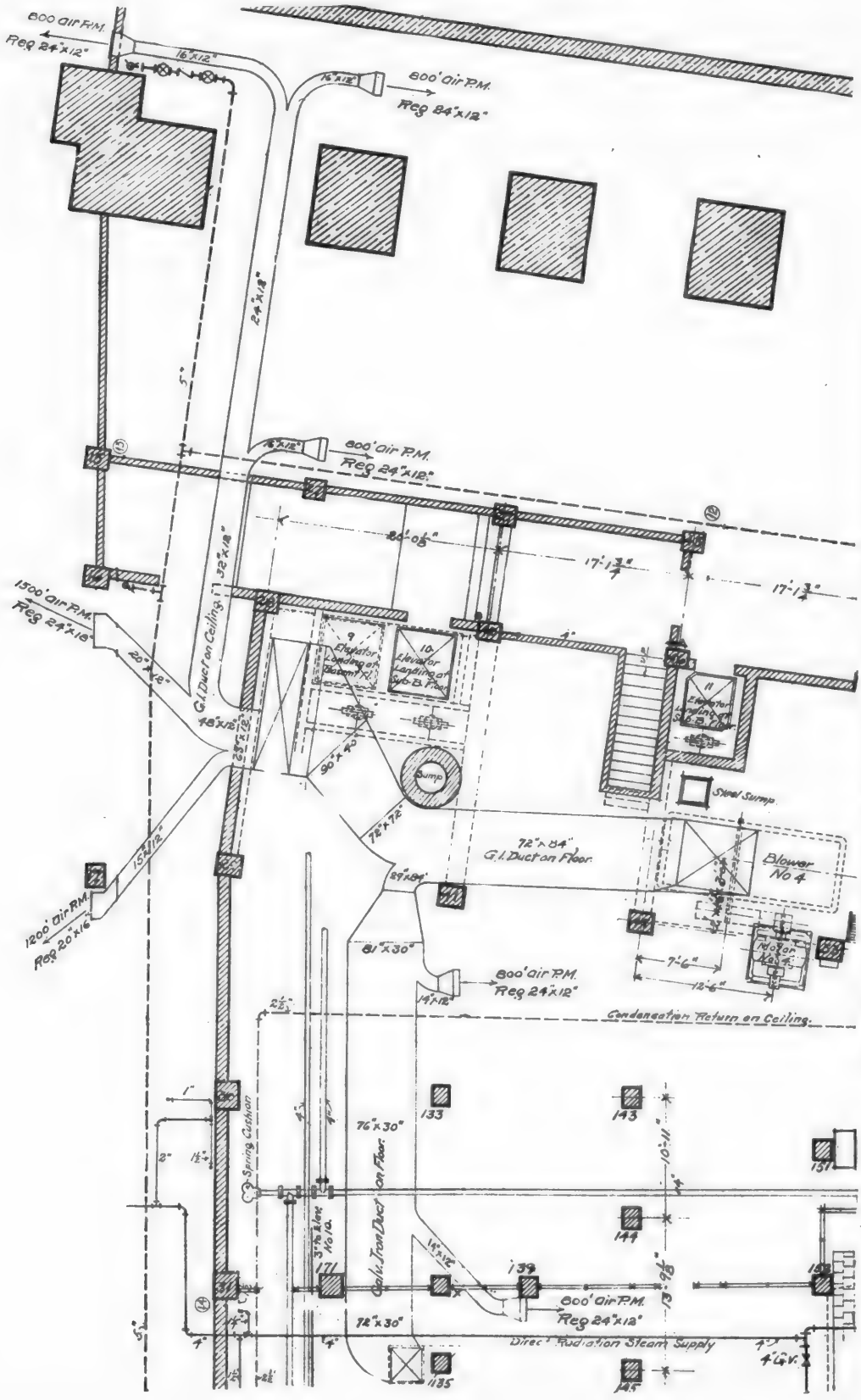
The tempering coils in the four apparatus groups are practically identical. Each group has three tempering coils with dimensions of 6 feet in length and 9 feet in height. Each coil has four rows of pipes deep, each coil having 3,375 sq. in. of free area and each coil having 1,300 lin. ft. of pipe, exclusive of ells and bases. There are also three sections of the same size, but two rows of pipe deep, having the same free area as the four row sections and having 650 lin. ft. of pipe in each section.

The re-heater sections, however, in the different groups vary slightly. In groups 1 and 2, for instance, there are 12 re-heater sections, 5x7 ft., having four rows of pipe deep in each, making 2,616 sq. in. of free area to each section, and having 1,009 lin. ft. of pipe in each section. There are also four re-heater sections of the same dimensions, but having two rows of pipe deep to each section, with the same free area as the four row sections and having 505 lin. ft. of pipe each.

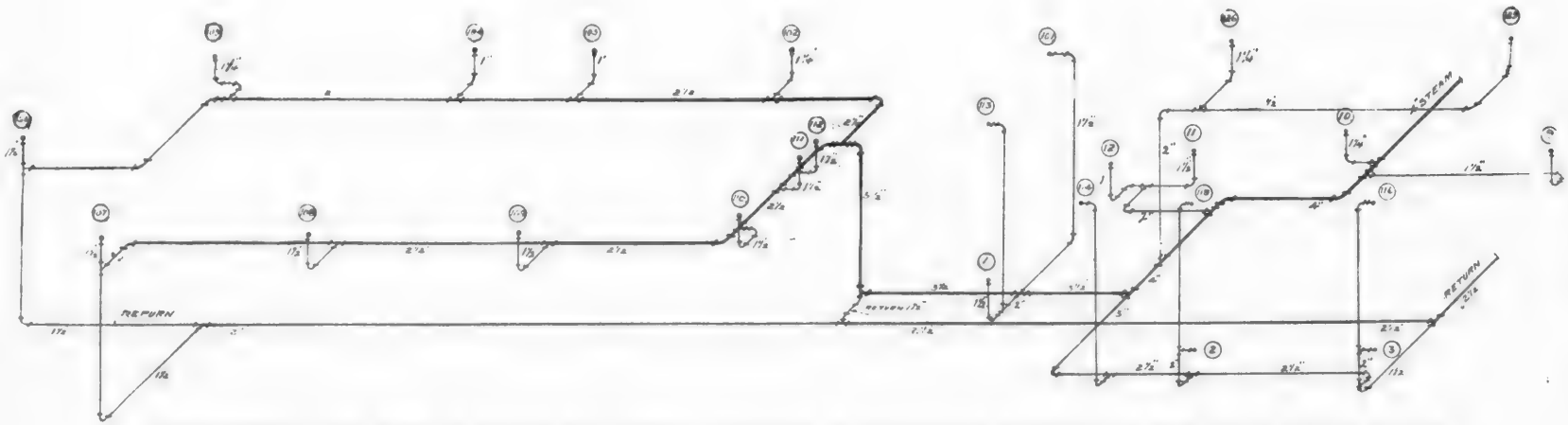
In groups 3 and 4 there are nine instead of twelve re-heater sections, having four rows of pipe deep, and three instead of four sections having double rows of pipe. The grouping



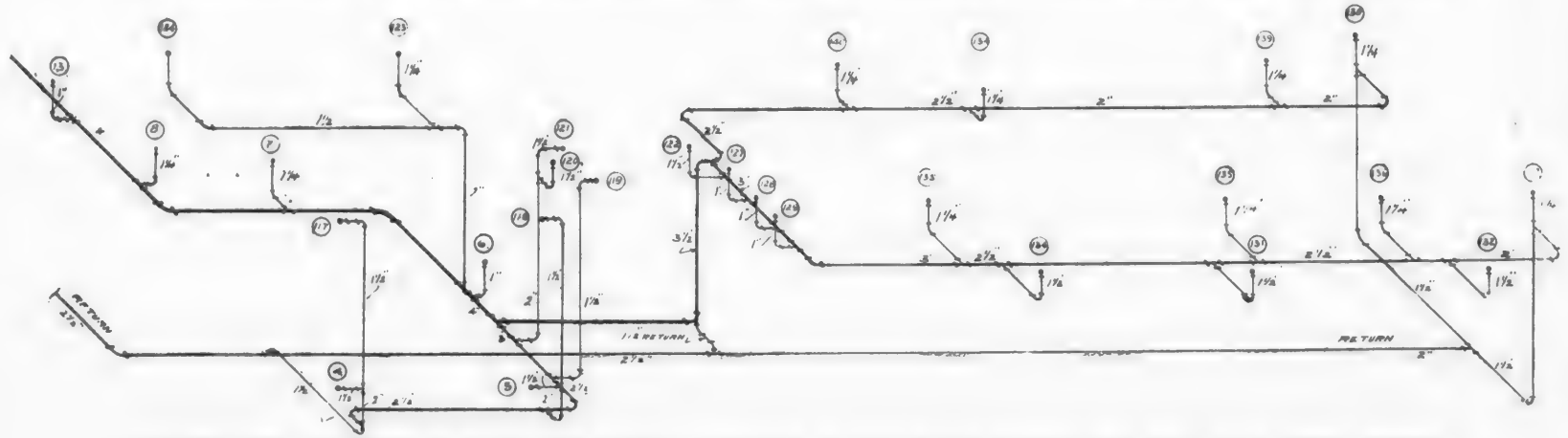
DETAILS OF INDIRECT HEATING APPARATUS, NEW YORK CUSTOM HOUSE. PLAN OF GROUP 1



BLOWER AND VENTILATING DUCTS OF GROUP 4, NEW YORK CUSTOM HOUSE.



ARRANGEMENT AND SIZES OF PIPING FOR DIRECT RADIATION IN POST-OFFICE SUB-STATION, NEW YORK CUSTOM HOUSE



ARRANGEMENT AND SIZES OF PIPING FOR DIRECT RADIATION IN POST-OFFICE SUB-STATION, NEW YORK CUSTOM HOUSE

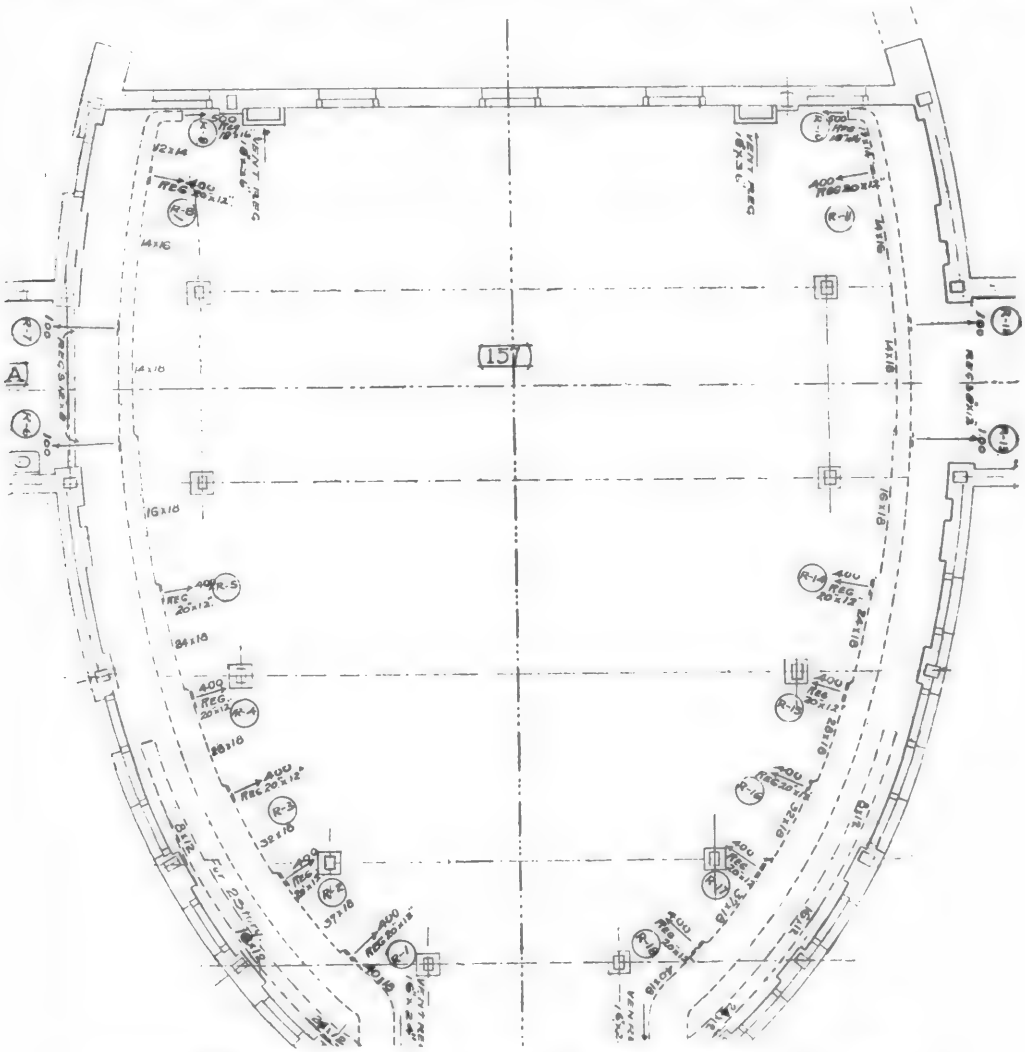
of the tempering coils and re-heaters is shown in the accompanying illustrations.

These groups are all inclosed in heavy sheet steel cases, bolted together and forming one continuous frame.

DUST REMOVAL

The dust is to be taken care of by a spray circulation tank located between the tempering coil groups and the baffle plate dry box in each apparatus group. It has a steel drip plate or apron from the baffle plate box sloping to about the center of the tank. There is a return connection in the side of each of these tanks.

The baffle plate dry boxes, by the way, which go with each apparatus group, are each placed at an angle of about 45° with the axis of the chamber, and will be alternated right and left so that the direction of flow of the air in passing through them will be changed at each plate through 90°. The angle iron on the furthest edge of each baffle plate is placed on the side of the plate over which the air slides, so as to catch the condensation and carry it to the floor.



ARRANGEMENT OF DUCTS IN ROTUNDA ON FIRST FLOOR OF NEW YORK CUSTOM HOUSE

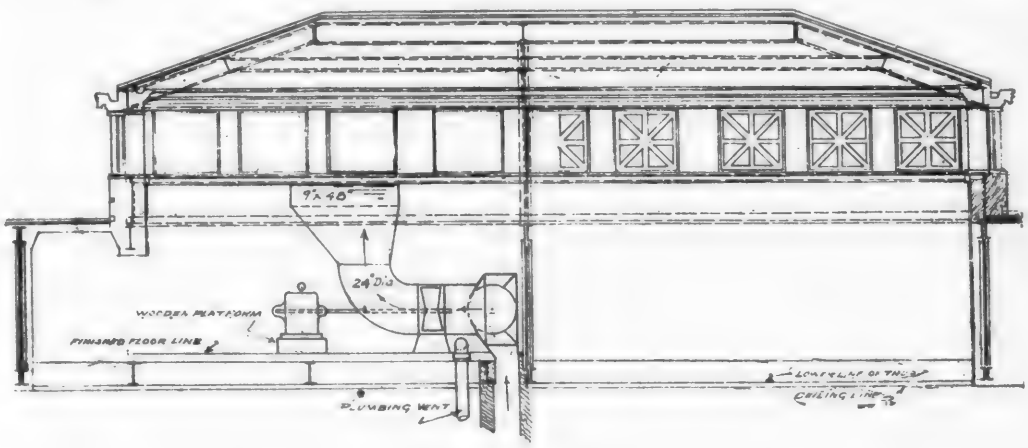
Each spray chamber has 44 spray nozzles in horizontal and vertical rows with eleven nozzles in each horizontal row. Each nozzle has a ca-

pacity for delivering one-quarter gallons of water per minute as a fine spray with hydrostatic pressure of 15 pounds.

EXHAUST FANS

In the elevator pent houses on the roof are four toilet room vent fans, exhausting the air from the main toilet rooms and discharging same by means of a separate discharge pipe from fans to ventilators.

Three of these fans are of the disc type, with a capacity of 2,500, 3,000 and 3,500 cu. ft., respectively, when operating at 400 R. P. M. The fourth vent fan is an 80-inch full housed steel plate peripheral discharge fan, with a capacity of 9,000 cu. ft. of air per minute, when running at 365 R. P. M. All of these fans are operated by electric motors. Mr. Cass Gilbert, of New York, is the architect of the building, and Mr. Burt S. Harrison, of New York, the consulting engineer. The construction of the system is in the hands of the New York Steam Fitting Company.



SECTION THROUGH PENT HOUSE "A," NEW YORK CUSTOM HOUSE, SHOWING VENT FAN, MOTOR, AND PIPING

*Steam Economy in Connection With the Heating Trade**

By O. M. Row

Before referring to economy in the use of steam, a few remarks on economy in the initial raising of the steam may be useful. In both cases the idea to be kept in view, and the object directly sought is identical—the reduction of fuel expenditure. This, in the latter instance, is largely dependent on the temperature of the feed water delivered to the boiler, and in the former to the careful re-transmission and utilization of units of heat once obtained.

With regard to feed water heating. The gain in fuel consumption resulting in heating feed water before delivery to a boiler has been found to average 1 per cent. for every 10 degrees rise in temperature, so that if we can introduce the feed water at 180 degrees instead of cold, a direct economy of 13 to 15 per cent. may, under favorable conditions, be relied upon, besides other advantages generally accruing to the boiler. This result may be readily obtained where exhaust steam is available by means of the exhaust feed water heater. In some case there may be no engine plant nor any exhaust steam to use,

*From a paper read at the summer meeting of the British Institution of Heating and Ventilating Engineers, Bristol, England, June 20-21, 1905.

out in many large institutions where there is an electric light plant, pumping machinery, laundry, etc., the exhaust steam (often largely wasted) is sufficient to heat not only the boiler feed, but in addition, a very large quantity of water for other general use, and strange as it may seem, it is correct to say that where power and hot water supply are required simultaneously, the latter may be had for nothing.

LIVE STEAM FOR FEED WATER HEATING

Reference should also be made to the use of live steam for feed water heating, and although still a subject for speculation and debate among engineers, there is, we believe, a growing feeling in favor of live steam heating, and some engineers certainly claim to have experienced considerable saving thereby. It is always adopted in marine work, which represents high-class practice and efficiency; while, on land, in cases where exhaust steam is not available, there is an undoubted economy of fuel effected by using live steam as against sending cold feed into boiler. It may be difficult to explain in theory how this economy comes in, but the fact remains. The writer has witnessed the effect of live steam heaters in marine practice in several instances where it was impossible to maintain speed, owing to the difficulty of maintaining steam when working without a feed heater, after fixing which no further trouble was experienced. The leading theory is that a steam boiler is best occupied flashing heated water into steam, rather than heating cold feed up to boiling point. Those who are specially interested may also be referred to an article published in *Engineering*, January 29, 1897, in which an instance is given of live steam heating in connection with a set of condensing engines 635 I. H. P. Other instances can be given, and certainly there are many cases where a live steam heater might be fitted with advantage. Apart from the economy of fuel, it promotes easier steaming and prolongs the life of the boiler, and when worked in connection with an economizer has been found to materially counteract the deterioration of the tubes.

An injector is a useful adjunct to a boiler and should always be fitted as a "stand by" for occasional us in overhauling pumps, etc.

It may be of interest to know that at the works with which the writer is connected, arrangements exist for feeding boiler either through injector, or by pump through exhaust or live steam heater—or both.

Descript'on of Tests.	Coal in lbs.	Water evpt. in gallons.	Initial temp of feed.	Temp. of feed, entering boiler.	Evapn. of lbs. of water per lb. of C al.	Evapn. from and at 212 degs	Coal saved % on evapn. from and at 212 degs
			Degs.	Degs. F.			%
With cold feed water....	784	374	65	65	4 77	5.72	—
With Live Steam Heater only.....	672	408	65	180	6 07	6 55	12.9
With Exhaust Steam Heater only.....	608	384	65	170	6.3	6.87	16.8
With Exhaust and Live Steam Heaters in Series.....	456	306	65	210	6.7	7.03	18.1

COMPARATIVE TESTS OF BOILER FED BY VARIOUS METHODS

Some comparative tests were made under ordinary working conditions, and the results are here given.

The boiler is a Cornish boiler 26 ft. by 6 ft. 6 in., having grate surface 22.75 square feet. The tests were in each case of three hours' duration and at a pressure of 135 lbs. per square inch.

BOILER SCALE

The subject of "scale" has an important bearing on economical steam raising and in reference to calorifier

work for water supply. We may here point out that for boiler feed, where water is bad and liable to deposit scale, a heater should be adopted having a good margin of efficiency to compensate for scaling. It should be accessible for inspection and cleaning when required. Where a large duty is required with feed water or calorifier, and the water is bad, it is advantageous to sectionalize the work, dividing the duty between several heaters arranged in duplicate or a series, so that one may be thrown out of use and dismantled for cleaning without interfering with supply. Another point in favor of above practice when frequent cleaning is necessary, lies in the fact that with smaller heaters the operation is much more readily and quickly effected, and it is easier to remake joints.

The latter is worth considering when working under high steam pressure, and experience shows that with all apparatus that require overhauling periodically, the smaller, more compact and easy to handle, the better. Special heating chambers are not always provided, and calorifiers have often to be fitted in very confined places, and if the engineer in charge has to lie on his back in some dark subway to open up, clean and rejoint a calorifier, we think he may be pardoned for the language he uses, and we can understand his disinclination to tackle the job. Meanwhile scale accumulates and duty falls off.

With regard to the actual fall off in duty of a boiler owing to scale, it is stated that a scale of 1/16 inch represents a loss of 13 per cent., while ¼ inch means a loss of 25 per cent. A good deal depends upon the nature of the scale, but as an average statement this is probably correct. A comparative test recently made with a strong calorifier, first in a perfectly clean condition, and again after being in use a month with hard water, and the tube surface scaled up in consequence, showed a fall-off of one-third in duty. The figures were as follows:

Quantity of water in calorifier, 200 gallons.

	With clean battery. Degrees F.	With scaled battery. Degrees F.
Initial temperature.....	59	59
At end of 3 minutes.....	92	62
At end of 4 minutes.....	108	86
At end of 5 minutes.....	118	106
At end of 6 minutes.....	130	116
At end of 7 minutes.....	140	—
At end of 8 minutes.....	160	—
At end of 9½ minutes....	180	148
At end of 15 minutes.....	—	180

COMPARATIVE TEST OF CALORIFIER, SHOWING EFFECT OF BOILER SCALE

The other conditions of the test were in each case identical. We think it will be readily understood from the foregoing remarks that any gain in fuel consumption arising from heating the feed water may very easily be lost through the scaling of the boiler.

It should be said that the proper method of obviating all this trouble is to reduce the hardness of the water and properly soften and filter it *before* it passes into heaters or boilers, but we must strongly deprecate the system of putting strong chemical reagents into boiler. Care should also be taken that no grease passes into boiler, and all heaters—especially those for exhaust steam use—should be of the surface type, so that the steam does not mix with the water.

ECONOMY IN THE USE OF STEAM

Turning now to the subject of the economical utilization of steam for hot water supply and warming, the two main points to be observed are:

1. To prevent condensation taking place without adequate value being returned.

2. To return the condensation necessarily formed in doing useful work back to the boiler as hot as possible, or turn its temperature to other useful purposes.

With regard to the first point. It is important to cover all steam mains, and to provide at suitable positions separators, or steam dryers, for collecting such condensation as cannot be avoided, and preventing it from passing along pipes to heaters or calorifiers. The object, of course, is to secure dry steam, but apart from this, the risks arising from accumulation of water in the pipes are too serious to be neglected. It deteriorates the jointing, and by setting up "water

hammer" action may be the direct cause of fracture. The following table is the result of an actual test with uncovered pipes, showing the amount of condensation at different pressures per square foot of surface. The test was made in the open with atmosphere 70 degs. Fahr.

Steam Pressure,	0	5	10	20	30	40	50	60	70	80	90	100
Condensation in lbs. per hour,	.73	.94	1.0	1.06	1.17	1.36	1.46	1.55	1.63	1.69	1.76	1.84

A case came before the writer not long ago of an installation in which serious trouble was experienced through condensation and loss of of pressure, and he was assured that after efficiently lagging the pipes, 70 per cent. of this loss was counteracted. Even with pipes carefully lagged, a certain percentage of loss through condensation still takes place, so that provision should always be made for collecting this at suitable intervals. To these points steam traps should be attached for discharging the condensation without loss of steam.

There are some people who have a mistaken notion about steam traps and their possibilities, and who seem to think that you have only to attach a trap to a steam main at any convenient spot, and it will, in some magnetic manner, draw all the condensation into it and discharge it. Cases have arisen in which traps have been blamed for not doing their duty, though the arrangements of the pipes and position of the traps absolutely precluded the possibility of condensation reaching them. A trap does not collect water. It merely discharges it, and a commonsense rule may here be given, viz.: Fix a trap at any point to which the water will naturally gravitate and accummulate.

An instance of the recognition of the economy and enhanced value of dry steam may be seen in connection with high-class engine work in the growing practice of re-heating and drying the steam during its passage from high to low-pressure cylinder, which shows the trouble taken in this class of work to secure the best results, and which may safely be looked upon as representing superior knowledge.

In heating work it is economical to carry high-pressure steam where possible. It enables pipes and fittings to be kept down in size, thereby reducing the first cost of the installation, while the relative heating value of the steam is much increased in proportion to the fuel used. The following table shows the efficiency of a square foot of indented heating surface at various steam pressures:

Steam in lbs. per sq. in.	5	10	15	20	25	30	40
Gallons of water raised from 50 degs. to 100 degs. F. in one hour..	35	42	56	62	80	93	103

It is frequently urged that there is not much difference in the temperature of steam at different pressures, but the results are governed by the efficiency of heat transmission through surfaces, which is a very different matter.

The following extracts from results obtained in an experiment recently made with a calorifier in connection with heat transmission efficiency will exemplify this.

Pressure of steam as per gauge.....	30 lbs.	50 lbs.	80 lbs.
Temperature of steam as per thermometer.	275° F.	290° F.	315° F.
Mean flow of heat in units of heat per min. per sq. ft, heating surface.....	1765	1970	2922

RE-USE OF HOT CONDENSATION.

With regard to the second point, about the re-use of hot condensation. This is a most important factor towards economy, and which is by no means fully appreciated. The amount of money thrown away in some large manufacturing concerns through condensation and exhaust steam being allowed to go to waste is quite considerable, and in these days when utilization of so-called waste products is made such a study, and carried out to such an extent in many businesses, it is simply astonishing that the re-use of condensation is so neglected. Yet when it is considered that this is discharged from traps at slightly under 212 degs. Fahr. the economy of returning it at once to boiler is apparent. In fact, there is a double economy, as it saves both fuel and water. It is specially important where hard water prevails, as it minimizes the amount of new water introduced to boiler, thus tend-

ing to keep down scale, as this condensation has already been freed from scale-forming and other impurities.

There are cases where the levels would allow of its naturally gravitating back to the boiler, but this is seldom practicable. The best plan is to lead all condensation to a suitable receiver, arranged in connection with a pump. This should, of course, be automatic in action, the admission of steam to the pump being governed by the amount of condensation in the receiver.

It may be found that the condensation is too hot for the pump to deal with, owing to its tendency to flash into steam at lower temperatures in vacuum. This may be counteracted by making use of lifting traps, delivering the water to an overhead tank, arranged with such a head that will operate against the above conditions. In other words, the head, or column of water must be sufficient to keep the cylinder charged with water, and counteract and overcome the tendency to form steam. Lifting traps must also be used in all cases where heaters and traps are below the level of the receiver, delivering the condensation into a main above, or into a tank fixed at some point from which a fall may be arranged.

Another economical method of dealing with condensation if conditions of temperature interfere with its being taken direct to the pump, is to transmit some of its heat, applying this to useful purposes and reducing the temperature sufficiently to allow the pump working with certainty. It should be borne in mind that, although reducing temperature of condensation returned to boiler, if the heat is turned to useful purpose in so doing, the economy remains the same. There are various ways of applying this, and it can be easily seen that, with careful arrangement, almost the whole of the calorific value of steam used may be turned to useful work, through a retransmission of heat in first instance and return to boiler of remainder.

The argument of this paper is in favor of the low-pressure hot water system, in which temperature is secured and maintained by calorifiers through which the water constantly circulates. We believe this to be the only system resulting in an absolutely good and healthy atmosphere for breathing purposes, which should be adopted in all cases, but especially so in institutions built for the care of the aged and infirm. It is well known that it is the only system that is successful in relation to plant life in the heating of greenhouses. Many large institutions and hospitals are built on the pavilion system, in so many separate pavilions or blocks, and it is in many cases considered best practice to arrange separate heating chambers in each pavilion, each fitted with its own calorifier proportioned to its requirements. Separate calorifiers should be used for the hot water supply, and for warming, so that the latter service may be entirely shut down when not required, though the former be required continuously all the year round. A suitable size steam main is provided, with branch services into each pavilion, and the condensation in like manner turned into a common main and all eventually returned to boiler.

The low-pressure hot water system may also be worked by fired boilers, but where steam is available, and in all cases where separate pavilions have to be dealt with, the application of calorifiers is more economical and advantageous in every way than separate fired boilers.

CENTRAL HEATING PLANTS.

The adoption of a central heating plant in such institutions as hospitals is being advocated and carried into practice by some architects and engineers, but for this to be a success, forced circulation must be resorted to. This consists of inserting a pump or circulator in the line of piping, by means of which the water in the mains is constantly sent round, or drawn back, instead of relying on natural circulation only. The pump is so situated as to deal with the water on its return, or in other words, at the coolest periods. This system is specially useful in ship work, steam yachts, etc., where the arrangement of

levels, rolling of vessels and other causes interfere with and retard natural circulation. Particulars of an experiment with forced circulation are here given in diagram form, and it will be at once recognized that without the circulator, no satisfactory result could be obtained. Several other systems of heating have lately been introduced, such as the Reck system and the Hornet system, all of which are worthy of study, and information concerning them may be obtained from the proper source.

It is not, however, the purpose of this paper to go into the subject of piping and circulating systems, nor would time permit. This should be specially considered by the heating engineers according to the requirements of each job in hand, as there is no doubt that the success of any installation depends considerably on the proper arrangement of the circulation, and the piping should be neat and unobtrusive.

REGULATION OF STEAM SUPPLY IN CONNECTION WITH CALORIFIERS

An important point in economy in connection with a calorifier is the proper regulation and control of the steam supply. This should be governed automatically, as without a reliable automatic control, there must either be considerable waste of time and trouble, in continually shutting down and readjusting the steam valves according to requirements, or (and this is what nearly always exists) a considerable waste of steam and water through valves being left open, and the water boiling away, when not required, through air pipes. This is obviously extravagant and wrong in principle, and there are many instances on record where the adoption of an automatic steam control has resulted in saving hundreds of pounds. With a reliable automatic control no waste of steam is possible, as it only comes into use when actually necessary.

In addition to the foregoing there are various other ways in connection with hot water supply in which the amount of fuel expenditure in steam raising may be reduced, and one of these which may be mentioned is the utilization of exhaust steam from gas engines.

There are many large institutions and manufacturing concerns in which large quantities of hot water are required and in which gas engines are employed, the exhaust from which might be usefully devoted to raising the temperature of the water supply and thus reducing the coal consumption.

SWIMMING BATHS.

Another subject which may be referred to as a matter of economy is in relation to swimming baths. This is a system of circulating, refiltering and aerating and reheating the water of the bath by which the temperature is maintained and the water rendered fit for use for a longer period. Here there is a double economy, as instead of running, say, 60,000 gallons to waste, refilling the bath and heating this amount up again, from cold by live steam, the same water is used over and over again, and the exhaust steam from the circulating pump is used for reheating. The water is drawn from the deep end of the bath and delivered to an aerator. From this, the water is distributed and falls over a series of perforated plates, dropping from one to the other through the atmosphere into a tank beneath. It then passes to the filter, and the filtered water in turn passes through the reheater and finally back to the bath, entering at the shallow end. Thus the whole of the water is treated, and the operation may go on continually without interfering with the bather. In reheating, the exhaust steam may, of course, be supplemented with live steam if found necessary.

INDENTED TUBES FOR HEATERS

For the transmission of heat, or, speaking more generally, for interchange of temperatures by surface contact, it has been found that in most cases the patent indented tube is doubly as efficient as a plain tube of equal surface, and is superior to all other forms. The form of indent necessary, however, varies according to requirements, and this has been made a special study, and much time

and money have been spent in experimenting on the subject.

EXAMPLES OF ECONOMY OBTAINED

A few examples are now given of economies suggested in this paper, and which have been successfully carried out in practice.

At an industrial school, where it was necessary to increase the hot water supply, and extra boilers were contemplated, the exhaust steam from the laundry engine, previously blowing to waste, was utilized in a calorifier and found to provide all that was required without further outlay. Several instances of this have occurred.

At public baths, the exhaust steam from the laundry engine, previously blowing to waste, was utilized in a calorifier and found to heat up not only sufficient water for laundry requirements, but in some cases to provide sufficient for private baths also. The system has been adopted in several new baths and washhouses built since.

A reference was previously made to the saving of time and trouble effected through fixing automatic steam controls to calorifiers. An instance may be mentioned of a large hospital in which the adoption of the patent automatic control throughout was said to effect a cash saving of £360 in the twelve months.

At an electricity station in a large city where the exhaust steam from main engines was going direct to condenser, an exhaust heater was arranged in the line of exhaust pipe, and it was found that a swimming bath in the vicinity could be filled at the required temperature by passing the water through this heater, at the rate of 25,000 gallons per hour.

In a manufacturing concern where a large supply of hot water was required to be at call, the exhaust steam was found to be ample to meet all requirements. A storage calorifier holding 600 gallons is at present fitted, heated by the exhaust steam, and it is proposed to connect this to two other cylinders of the same capacity, as the exhaust previously wasted will easily provide 1,800 gallons of hot water.

At the large public baths where condensation from steam mains and exhaust steam from pumping engines were blowing freely to waste, the utilization of these was found to effect a saving of 80 tons of coal per annum.

In conclusion, it may be said that these cases are purposely given in a general way only, being such as may be met with constantly, and the final argument of this paper is that in all cases involving hot water supply and kindred requirements, we should be "watchful for waste," and, finding any, should ask ourselves, "Can this be utilized in any way for the purpose?"

*Air Heater Tests**

By O. M. Row

Some air heater tests have been made, the results of which may be of interest. The tests were made for the purpose of finding the output of air heaters under different conditions. These heaters were constructed with indented tubes, the heater used consisted of four batteries of 1¼ in. original bore, steel tubes 1/16 in. thick and indented. These tubes were expanded at each end into mild steel tube plates, the tube plates being connected to cast iron boxes at top end for steam inlet, and to cast iron boxes at the bottom for drain outlet. There were twenty tubes in each battery, 3 ft. long, giving a surface per battery of 28 square feet, the four batteries composing the heater thus giving a total heating surface of 112 square feet. The heater was covered with a sheet iron casing connected at one end to the inlet side of a fan, the other end of the heater being open to the atmosphere. The heater was arranged with a steam inlet valve to each battery, these valves being connected to a reducing valve which was in turn connected to the live steam

*From a paper read at the summer meeting of the British Institution of Heating and Ventilating Engineers, Bristol, England, June 20-21, 1905.

from the boilers. The bottom end of each battery was supplied with a separate valve and pipe leading to a tank for measuring condensation.

As is well known, the transference of heat through any substance depends upon the difference of temperature on each side and upon the thickness of the substance, so in the air heaters the flow of heat from the steam inside the tube to the air on the outside of the tube depends upon the temperature of the steam and upon the temperature of the air. The thickness of the tubes, being constant, can be disregarded. Besides this, there is another factor which materially affects the transference of heat, and that is the speed of the air through the heater, and also the passage of the steam through the tubes. Where the latter is broken up by means of indents the transference of heat was much larger than through plain tubes, and as the speed of air is increased the amount of heat transmitted per unit of surface is also increased. The efficiency of the steam tube is also affected by the means provided for the removal of the condensation. This is direct and positive where the steam enters the top and the condensation is removed from the bottom of the tube; but where the

Steam pressure	Volume of air cubic feet per minute	Inlet temp.	Outlet temp.	Rise in temp.	Condensation per square foot of surface in pounds
		Degs. F.	Degs. F	Degs. F.	
15 lbs.	2000	84	156	72	1.6
"	3500	88	149	61	2.2
"	5000	80	139	59	2.4
50 lbs.	2000	85	175	90	2.3
"	3500	83	165	82	3.0
"	5000	81	158	77	3.2
100 lbs.	2000	76	192	116	2.7
"	3500	77	172	95	3.5
"	5000	79	170	91	4.1

TABLE 1.—SHOWING THE EFFECT OF VARYING STEAM PRESSURES UPON THE TEMPERATURE OF THE AIR DISCHARGED, UNDER SIMILAR CONDITIONS, AT THREE DIFFERENT SPEEDS

Working pressure	Cubic feet per minute	Rise in temperature of air per battery when using four batteries			
		1	2	3	4
		Degs. F.	Degs. F.	Degs. F.	Degs. F.
15 lbs.	2000	25	16	16	12
"	3500	20	19	14	11
"	5000	18	15	13	10
50 lbs.	2000	30	24	20	16
"	3500	26	21	18	15
"	5000	23	19	17	14
100 lbs.	2000	35	31	27	23
"	3500	33	26	22	20
"	5000	28	23	20	18

TABLE 2.—SHOWING THE RISE IN TEMPERATURE OF THE AIR OBTAINED FROM A VARYING AMOUNT OF SURFACE, IN THE PROPORTION OF 1, 2, 3 AND 4, THIS BEING THE NUMBER OF BATTERIES IN EACH CASE, RESPECTIVELY

steam enters the bottom of one end of tube, forming a vertical loop, and the condensation passes out of bottom of other end, there is a reduced efficiency in the heating surface, owing to some of the tubes becoming choked by the welling up of the condensation water.

It will be seen from the above that the colder the air that comes in contact with the tubes the more efficient will be the heating surface, and therefore where a number of batteries are being used in series, the first battery receiving the coldest air will do the most work, the second battery receiving air that has already been partially warmed doing diminished work, and so on.

The object of this test, therefore, was to obtain no fewer than three different cases of each of the conditions affecting the efficiency of the heater. The heater was worked with six different steam pressures—viz., 0 equivalent to exhaust, 15, 30, 50, 75 and 100 pounds pressure. At each of the above pressures three different volumes of air were passed through 2,000, 3,500 and 5,000 cubic feet per minute, and at each pressure and at each volume the result was obtained from one, two, three and four batteries of tubes. The tables on the opposite page will give some idea of the results obtained from the tests.

From the tests it was found that the condensation per square foot of surface in this heater was larger than in any other type, the chief advantages being:

1.—Compactness, and, therefore, smaller cubic space required for the apparatus.

2.—Positive action inside the steam pipes, the condensation flowing to the bottom and passing away to steam trap.

3.—The absolute freedom from leakage in the steam pipes owing to the method of construction.

The tables of duties given will speak for themselves as to the capabilities of these heaters.

*Heating and Ventilating Large Buildings—Dust Deposition**

By Prof. W. F. Barrett

All heating appliances depend upon the transference of heat from some source to the parts of the building it is intended to warm. I need hardly remind you that this transfer can be effected in three ways: by the slow process of conduction, by the quicker process of convection or by the swift process of radiation. In the case of hot water pipes all three processes are at work; the heat is conducted through the iron pipes, which warm the room both by radiation and convection. In the case of an open fire radiation is practically the only agent by which the heat is distributed to the persons in and to the walls of the room. As the air is almost as transparent to radiant heat as it is to light, the air of a room cannot be warmed by radiation, and hence domestic open fire grates warm the room indirectly by heating the floor, walls and furniture, and these absorbing the radiant heat warm the adjacent air by convection. This latter process consists, as you are aware, in the transfer of heat by moving masses of the warmed air or other fluid, the motive force being gravity, the colder, denser air displacing the lighter warm air. These currents are the means by which all fluids are heated, as both gases and liquids are extremely bad conductors of heat.

TEST WITH A GLASS GLOBE

A few years ago a makeshift mode of warming a small room was introduced, which is no doubt familiar to you; the ordinary glass globe round a gas flame was replaced by an enameled iron globe closed at the top. At first sight it would appear that such an arrangement would simply obstruct the light of the gas flame and give no heating advantage. But as a matter of fact a small room can

*From a paper read before the British Institution of Heating and Ventilating Engineers, Bristol, England, June 19-20, 1905.

be much more quickly warmed in this way than by a naked gas flame. I made several experiments during one winter to test the matter. By suspending thermometers at different heights above the floor the naked flame was found, as might be expected, to heat the upper layers of air near the ceiling, as its heat energy was chiefly expended in producing convection currents; hence the walls of the room and the lower strata of air were hardly warmed at all. With the iron globe on a very different result followed. The temperature of the air near the ceiling rose but slightly; the heat energy was now largely expended in radiation from the hot globe, and to the walls of the room and thus the atmosphere in the lower part of the room was comfortably warmed. Thus the paradoxical effect is explained, greater heating efficiency being produced without any increase in the consumption of gas. Of course, the system is a bad one owing to the vitiation of the air by the products of combustion, but the atmosphere of the room can be changed after the gas is extinguished and the walls will still retain a certain warmth.

I only mention this in passing to show that an elementary knowledge of experimental physics enables one to clear up the anomalies that frequently arise in the course of our work.

ADVANTAGES AND DISADVANTAGES OF PLENUM SYSTEM

Now let me turn for a few minutes to the vexed question of the heating of large public buildings. Few systems have excited more animated, and in some cases interested, controversy than that which has been called the plenum method of combined heating and ventilation. Some architects are apt with too little discrimination to specify this system in the various public buildings they design. But as you are all aware, the plenum system, while it has merits of its own, has also very grave defects, and when used at all must be used with great discrimination and only applied to special cases. The advantages of the system may be briefly stated to be: (1) The evenness of temperature produced; (2) the ventilation of the building is concurrent with its warming; (3) the air can be drawn from sources free from contamination and can be filtered from suspended impurities, warmed and brought to the proper hygrometric state before its introduction to the different rooms or wards; (4) the degree of temperature and of ventilation can be easily controlled in any part of the building, and (5) the removal of ugly pipes running through the rooms has a great architectural and esthetic advantage. These are great merits. As for the economy of the system the evidence appears to be conflicting, but it must be remembered that in the plenum system double work is done, the air is not only warmed, but perpetually being changed; the ventilation is concurrent with heating, and, therefore, in considering the question of cost, it is only fair to remember it combines two different operations.

On the other hand, the disadvantages of this system for the heating of ordinary buildings or colleges are very great: (1) The most obvious is that no windows can be opened nor doors left open; double doors with an air lock between must also be provided if the doors are frequently opened and closed; (2) the mechanical arrangements are elaborate and the system requires to be used with intelligent care; (3) the whole elaborate system needs to be set going even if only one or two rooms in a large building require to be warmed, as often happens in the winter vacation of a college; (4) the temporary failure of the system, through the breakdown of the engines or other cause, throws the whole system into confusion, and if, as in the Royal Victoria Hospital, the windows are not made to open, imminent danger results; (5) then, also, in the case of hospital wards and asylums it is possible that the outlet ducts may become coated with disease germs, and unless periodically cleansed, a back current through a high wind or

temporary failure of the system may bring a cloud of these disease germs back into the wards. As a matter of fact, the warm vitiated air will deposit a layer of dust or disease germs on the cooler sides of duct through which it passes; this question of dust deposition I will return to presently.

FAULTS OF MECHANICAL VENTILATION

Nor do I like the plan of introducing the pure warm air at a high level and extracting the foul air at a low level, though this does not seem essential to the system; it is, moreover, very doubtful whether a complete renewal of the air in a room or ward does take place. Unless the air be kept in agitation I imagine a current of pure warm air would pass from the inlet to the outlet, leaving stagnant portions of air above and on either side of the inlet. There are, undoubtedly, many buildings to which the plenum system is entirely unsuited and objectionable, and there are some where it seems an eminently good system, such, for instance, as the crowded waiting room of a hospital or police court, or an operating room of a hospital, or for rooms or halls or churches where a crowded audience assembles and where open windows are rarely to be found, or cannot be permitted owing to outside noises, etc. In these cases, however, any system which, without creating drafts, supplies fresh warm air, is suitable and the determining factor is the question of economy and simplicity.

LACK OF KNOWLEDGE REGARDING LARGE BUILDINGS

It is much to be regretted that we have so little exact knowledge of the best system of heating and ventilating large buildings. Professional and commercial interests are apt to obscure the truth when papers are read or discussions occur on any special system. Moreover, to determine what is best involves not only the question of efficiency and economy, but also of healthiness and convenience.

As regards steam heating, one disadvantage is obvious that no heating occurs until the water in the boilers is actually generating steam, whereas in a hot water system the circulation and warming begin directly heat is applied to the boiler. Those who have had experience of different systems of heating large buildings, I find generally concur in giving the preference to hot water circulation, independently of the ease with which it can be controlled. The heating of hot water radiators by injecting high presure steam seems to me one of the simplest and best ways of transmitting heat throughout a building.

HEATING BY ELECTRICITY

Ideally, of course, electric heating would be the best, as the electric current could be conveyed with the least possible loss throughout any building, and then by traversing suitable resistance coils the current can be made to generate heat in any room and at any moment by merely turning on a switch. But at present this system is impracticable, except as a luxury, owing to the cost of electricity. In the neighborhood of a waterfall, however, the utilization of the energy of the fall and its transformation into electricity—and thence to heat—would be a practical project, for the heat generated by the current is proportional to the square of the current strength into the resistance of the radiating coil. The difficulty of finding suitable resistances (for the radiating coils) which will stand a high temperature without disintegration would no doubt be surmounted if electric heating became general. As a matter of fact, some excellent plans have been adopted which are well known to electricians, but I need not go into those here, except to mention that some of the remarkable alloys of steel, made by Mr. Hadfield, of Sheffield, have an enormous electric resistance and give promise of utility in the direction of electric heating.

HOT WATER HEATING BY MEANS OF STEAM INJECTION

To return, however, to hot water radiators heated by injecting high pressure steam, one objection has been the noise made by the injected

steam. Anyone can hear this by allowing steam to escape from a pipe held below the surface of the water, a noisy rattling and bumping occurs until the water is raised to a boiling point. But a noiseless steam injector has been made, and is in use, so that this objection is removed. When, therefore, there is waste steam, at say, 40 to 50 pounds pressure, coming from a boiler used for power purposes, nothing could be more economical nor simpler than to utilize this steam for the transmission of heat by injecting it into a hot water radiator whenever needed. Properly jacketed steam pipes are used in America to convey heat and power to remote distances, and I do not know why the system of heating by steam injected into water radiators has not become more general; the circulation of the water is accelerated by the steam jet and the regulation of the heat in any room is perfectly under control by simply turning the steam jet on or off. The economy of this system, when special high pressure steam boilers must be supplied for the purpose, is a question worth careful examination; I am inclined to think it would show favorably if the boiler were also used to drive an engine and fans for the ventilation of the building.

DUST DEPOSITION

In all these systems the air is warmed, and the walls of the room are therefore cooler than the air, and it is a matter of common observation that when this is the case the walls became rapidly covered with dust and dirt. On the other hand, when the room is warmed by an open fire the air is not heated by the radiation from the fire, but the walls are, and it is the warm walls which warm the room. When this is the case—the air being cooler than the walls—very little dust and smoke is deposited on the walls, which therefore remain cleaner much longer than in a room which is heated by warm air. This is notably seen in the difference between the wall papers in a room heated by an open fire and a room heated by a stove; in this latter case the wall papers became rapidly disfigured and dirty by an unsightly deposition of dust. Many are under the impression that this is due to the dust and dirt caused by the stove or the leakage of smoke through the joints in the stovepipe, but that this is not the cause is seen from the fact that gas stoves give rise to precisely similar dirtying of the walls as coke stoves, and, as I have said, so do systems of heating by hot air. In fact every one must have noticed the upward stream of dust and dirt that attaches itself to the wall in the immediate neighborhood of a radiator, whether that radiator be warmed by hot water, steam or gas. So great and so constant is this disfigurement that it has been urged as an objection to the use of radiators and heating by hot water pipes, and in some cases the radiators are placed in the middle of a room or far from the walls to get rid of this annoyance. The same thing may be noticed where hot water pipes run along the wall; near the pipes this wall gets blackened.

Probably few, if any, of those present have thought of the reason or been able to find a reason, for this annoying disfigurement. Clearly it cannot be due to any dust created by the radiators, for they are perfectly clean surfaces. It is, therefore, a matter of some importance to try and ascertain the cause and thus, if possible, remedy this defect in the use of all radiators. For this purpose we must turn to physics, and the investigations of Aitken in Scotland and Lodge in England on the phenomena of the deposition of dust have in recent years given us the solution of this curious and important practical matter.

EXPERIMENTS WITH DUST

Many years ago Professor Tyndall noticed that when dusty air was strongly illuminated by a sunbeam or by the electric light, there rose from the summit of any heated body placed within the dusty air a stream of dust-free air. This was rendered apparent by its not scattering the light; and hence a fine black stream was seen rising up from the hot body.

Any one can see this by heating a wire or rod of metal and putting it in a glass vessel filled with smoke; upon brilliantly illuminating the smoke a sharp black line will be seen above the hot line or rod. Tyndall, Frankland and Lord Rayleigh have given different explanations of this experiment, but none were satisfactory. Professor, now Sir Oliver, Lodge and his demonstrator, Mr. J. W. Clark (a former student of mine), took up the matter and their numerous experiments and suggested explanation were published in *Nature*, July 26, 1883, and in the *Philosophical Magazine*, March, 1884. Almost simultaneously Mr. Aitken in Scotland began working at the matter and arrived at much the same explanation as given by Professor Lodge; the beautiful experiments made by Mr. Aitken were published in a paper read before the Royal Society of Edinburgh in January, 1884.

DUST IS DRIVEN AWAY FROM WARM SURFACES

The general result of all these experiments showed that the invariable tendency of fine dust particles is to be driven away from warm surfaces and to deposit themselves on any neighboring cold surface. The dust-free stream of air rising from a hot body is caused by the warm body being surrounded by a dust-free coating of air, and the ascending current of warm air carries this dust-free layer with it, giving rise to the dark stream line seen above the warm body. It is true that a dark stream line of dust-free air is seen descending from a cold body, but, as Mr. Aitken has shown, this is not an effect of temperature, but is the result of the action of gravitation on the dust; the solid body shielding the space immediately below it from the settling down of fine particles of dust, and the cold body causing a descending stream of air.

THE MIRROR EXPERIMENT

Many striking experiments were made by Mr. Aitken to show the tendency of dust to leave a warm surface and attach itself to a cooler surface. Thus if two mirrors, one hot and the other cold, are fixed face to face near to each other and placed for a few minutes in a vessel filled with a dense cloud of dust, formed by burning a little magnesium wire within the vessel, it will be found when the mirrors are removed that the warm mirror is perfectly clean, while the cold one is coated over with magnesia dust. Or if two glass rods, one cold and the other hot, are dipped into some hot magnesia powder and then taken out, the warm rod will be found to come out quite clean, but the cold rod is thickly coated with an adhering mass of powder.

APPEARANCE OF TIMBER FRAMING THROUGH PLASTER

But the most interesting illustration of the repulsion of dust from a warmer to a cooler surface is seen in a photograph of the wall in my study at the Royal College of Science, Dublin, a room heated by a gas stove. The end walls are timber framing with plastered and painted surface. Wherever the wood framing occurs the wall is clean, whereas the rest of the wall is darkened by adherent dust. In fact the wall appears to become transparent, showing the wooden studs through the plaster. This is due to the fact that the wood, being a bad conductor of heat, remains warmer than the adjacent plaster, and hence the dust leaves the part where the wood is beneath and attaches itself to the cooler plaster. The same effect is sometimes seen on plastered ceilings.

It looks as if the old idea of a repulsive force produced by the heat was after all correct. In fact, if we heat in a crucible any fine incombustible powder such as magnesia or silica we shall see the particles of the powder become self repellant and mobile, like a liquid. Heat, we know, does lessen the cohesion of bodies, making a rigid and brittle body, like glass, to become ductile and viscous; it does drive the molecules of bodies further apart, causing a cubic inch of water to become nearly a cubic foot of steam, or 273 cubic feet of air at the freezing point to become 373

cubic feet at the boiling point. But the expansion, and the change of state from solid to liquid and liquid to gas produced by heat, is due to the greater amplitude of vibration, the increased width of the swing, of the molecules of a body, and does not necessarily involve a repulsive force radiated from the hot body, though its kinetic energy is increased by heat.

SIR W. CROOKES' RADIOMETER

How then can we explain the curious effects I have mentioned, of dust repelled from a hot surface and attaching itself to a cold surface? Probably every one present is familiar with Sir W. Crookes' radiometer, that beautiful little heat mill, with vanes black on one side and bright on the other, pivoted in a highly exhausted glass globe. The vanes are rapidly driven round on the approach of a warm body, or by the warmth of the sun, or a distant flame. Here the heat can only reach the vanes by radiation passing through the glass and the exhausted globe; the radiation is absorbed by the blackened surface of the vanes; this side is therefore warmed and is instantly repelled. The true explanation of the motion of the vanes was suggested in the first instance by Crookes and afterward explained more fully by Dr. Johnstone Stoney and Prof. Osborne Reynolds. It is due to the fact that, although the radiometer has been exhausted to a higher vacuum than any ordinary air pump can produce, nevertheless there are millions upon millions of molecules of air still remaining in the little glass globe. All these molecules are in incessant and rapid motion, bombarding the interior of the vessel and the vanes of the radiometer with their impacts, which occur billions of times in every second. The pressure of all gases is due to this bombardment and proportional to it; hence on the outside surface of the glass vessel the bombardment is vastly greater than on the inside surface, for the full atmospheric pressure is outside, while inside there is a high vacuum; but the glass is strong enough to bear the stress of these molecular projectiles. When the temperature is uniform inside the vessel, the vanes are unmoved by the bombardment, for it is exactly equal on both sides of each vane. If, however, the temperature of one side of the vane be raised the molecules of air adjacent to it are warmed; an increased velocity and therefore greater energy, is thus given to them and the rebound of these molecules drives the blackened face backward. But to keep up this difference of pressure on the two sides of the vane, the warmed molecules must be continually cooled; they expend their increased energy or warmth partly on their neighbors and partly on the cooler glass of the vessel. Hence between two adjacent surfaces, if one be kept cooler than the other, a pressure exists, and this has been called Crookes' pressure, from its discoverer. You will therefore see that if we removed all the molecules from the globe, if we perfectly exhausted the radiometer, the vanes would not move. This is the case, and, in fact, this is one of the best tests we have of a very perfect vacuum.

Now it has been suggested that this repulsion of the dust from the hot surface is due to a cause similar to that which rotates the vanes of the radiometer; it is true the width of the layer of dust-free space is much greater than we should expect in air at ordinary atmospheric pressure. But the dust particles are very minute and very light, and there can be no doubt that owing to this cause the molecular bombardment from the hot surface is towards a colder surface. This molecular convection does not, however, extend very far, and probably ordinary convection currents come into play and carry the dust particles across to a distant cool surface. There are, however, some phenomena connected with this subject which seem to require fuller investigation and explanation.

Here, however, we have a practical means of filtering air from dust, it is only necessary to have two concentric tubes, the inner one conveying steam and the outer one kept cold; any dusty air passed between the hot

and cold tube will deposit its dust on the inner surface of the cold tube, and much finer dust or germs can be so deposited than can be stopped by filtering through ordinary screens.

DUST PARTICLES IN RAIN

Mr. Aitken has shown that every drop of rain has a nucleus of some sort—usually a dust particle. In fact, the ease with which vapor condenses to fog is a test of the presence of numerous smoke or dust particles. If there are few dust particles in the atmosphere the vapor forms a mist or fine rain and the purity of mountain air no doubt explains the mountain mists so frequent in the Highlands. Were there no nuclei at all, condensation would not occur. This discovery led Mr. Aitken in 1893 to devise a pocket dust counter. The air in a small vessel is first rendered dustless and exhausted by a simple device, and then a sample of the air to be tested is admitted. This is chilled by partial exhaustion and the condensed vapor falls down to a plate in tiny droplets, each drop having a dust nucleus. By counting these drops in any small area, the number of dust particles in a given volume of air is found. Thus in the purest mountain air about 250 dust particles per cubic centimeter were found. In clear country air 500, while in London and Paris the number of solid particles varied from 80,000 to 210,000 per cubic centimeter. Mr. Aitken's ingenious little instrument should be in the hands of every engineer, so as to test the value of the screens used to filter the air admitted to the buildings.

The following are some of the conclusions arrived at by Mr. Aitken:

1. The earth's atmosphere is greatly polluted with dust produced by human agency.

2. This dust is carried to considerable elevations by the hot air rising over cities and from the sun heated areas of the earth's surface and by winds driving the dusty air up the slopes of hills.

3. The transparency of the air depends on the number of dust particles in it and on its humidity. The less dust and the dryer it is the more transparent it is. . . . Water apart from dust does not seem to affect its transparency.

4. Haze is generally produced by dust. If the air be dry the vapor has little effect, the density of the haze depending chiefly on the number of dust particles present.

5. The dust particles in the air have vapor condensed on them, though the air itself may not be saturated.

6. The amount of vapor condensed on the dust in unsaturated air depends on the humidity of the air. The higher the humidity the greater the moisture held by the dust particles when the air is not saturated.

7. The amount of dust in the atmosphere of pure country districts varies with the velocity and the direction of the wind. Fall of wind is accompanied by an increase in dust. Winds blowing from populous districts generally bring dusty air.

CLEARING AIR OF DUST BY MEANS OF ELECTRICITY

There is another way of ridding the air of dust which has been the subject of a good deal of experiment by Sir Oliver Lodge. That is the discharge of electricity from a point, even a small electric machine can quickly clear a large bell jar of a cloud of smoke or dust by discharging its electricity from a point in the bell jar. Possibly at some future date the atmosphere of smoky and foggy towns may be rendered clear by continuous and powerful electric discharges. The coating of dust over the leads of electric wires is often noticed, especially in the flexible wires which suspend incandescent lamps. This is simply an effect of electric attraction on dust in the air, a larger quantity of dust accumulating on that lead which has the higher electric potential.

But I must not pursue this interesting subject of dust any further, it has already afforded a wide subject, having many practical applications; but the subject is far from exhausted, we have still much to learn regarding the phenomena associated with it.

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HEATING a large building like the United States Custom House, in New York, by the plenum system exhibits a type of plant that is seen more frequently in the West than in the East. In some of its features it emphasizes the assertion we hear made that too often in eastern cities are the conservative, tried-and-true plans of the past adopted in new work, while better methods, or, at least, those more up-to-date, are looked on askance, until so thoroughly proved as to fairly force recognition. An engineer, who recently designed an important, but not particularly complicated heating plant, in an Eastern city, furnished an illustration of the point in mind when he said: "The layout is not the one I first designed. I had something there that would have made heating engineers sit up and take notice. While I knew it would work, I didn't quite dare put it in."

THIS matter of comparison between the methods of Eastern and Western heating engineers is something that is taken with a good deal of complacency in the East. Here the profession seems willing to let the West have all the credit it desires for the advances that are made, reserving only the privilege of applying what seems most likely to prove profitable, and in the long run, perhaps, being accorded most of the glory. Many engineers, for instance, predict that the East will eventually be honeycombed with central heating stations and that we will all buy our heat, just as we now buy our gas and water. Well, in the Middle West, both in the natural gas districts and elsewhere, this is being done on a scale that is only fully realized by those on the spot. "The East will take up the idea after a while," said a Cleveland heating man, with just a touch of sarcasm. "Give 'em time."

CONSIDERABLE space is devoted in this issue to the recent meetings of the British Institution of Heating and Ventilating Engineers, at Bristol, England, and the German Society of Heating and Ventilating Engineers, at Hamburg, Germany. Both associations are fairly representative of the profession in their respective countries and the papers read at their proceedings and those read at the heating engineers' meetings in this country ought to form some basis of comparison as to the progress of the art here and abroad.

However, they do so only to a degree. The British Institution is really still in its infancy. Moreover, it serves the objects sought in this country by both the Master Fitters' Asso-

ciation and the American Society of Heating and Ventilating Engineers.

The German Society, however, is an older affair and, although, at this writing, we have only the published reports of the meeting to guide us, it is doubtless true that many of the papers and not a little of the discussion would be considered on this side as treating of matters well understood by the bulk of the profession. Indeed, as Councillor Rietschel frankly admitted, in the course of his remarks on "The Future of the Heating and Ventilating Profession," "America is far ahead of us in this respect (heat regulation), as more is expended there for heating and ventilating systems than is spent here, where, in so many cases, only the means are provided for the essentials."

ONE of the first achievements of the new administration of the National Association of Master Steam and Hot Water Fitters is the appointment of a Committee, headed by Mr. Arthur C. Walworth, of Boston, and including Mr. Burton P. Hall, of New York, and Mr. E. M. Nichols, of Philadelphia, to standardize weights for wrought iron and steel pipe and to standardize weights and tappings for valves and fittings. This task, though bound to be a tedious one, is worthy of the Association. The previous efforts of the Association along this line, resulting in the excellent standards now used for pipes and pipe flanges will, no doubt, stimulate the efforts of the Committee and to many are an assurance of a successful outcome of the present investigation.

THE growth in the artistic appearance of manufacturers' catalogues is noteworthy, even at this time, when so high a standard has been developed in the typographical features of these publications. It is significant that two catalogues, issued during the past month, one here and the other in England, are easily the finest example of the printer's art yet seen in the steam fitting trade. It is even more significant that neither of these publications conform, even approximately, to any of the standards that have been suggested by the various societies that have taken up the matter of uniformity of advertising matter. It might be said, with truth, that these publications are so entirely out of the ordinary as to be worthy of a place by themselves. Yet it is a fact that the greatest use of them will be made by heating engineers and architects rather than by the public. This being so, their most useful place will be on the office shelf, where, owing to their sizes, there may or may not be a space suitable for them.

WE take pleasure in announcing a series of articles by Prof. John H. Kinealy, of St. Louis, on designing and proportioning piping for conveying air. The first article will appear in the September number and will be entitled "Friction of Bends in Air Pipes." This, as well as the subsequent papers, will be copiously illustrated. It will be of interest to know that Professor Kinealy's forthcoming series will be in amplification of his paper presented at the Chicago meeting of the heating engineers.

WE would announce that accepted letters for the Correspondence Department of this Magazine, containing practical suggestions or relating experiences that are of value to those interested in heating and ventilating, will be paid for in cash.

An English Opinion Regarding the Heating and Ventilating of American Theaters

Comparisons are always interesting and those drawn by an English engineer, Mr. J. D. Sutcliffe, between the warming and ventilating arrangements and fire appliances in English and American theaters are especially timely, owing to the fact that Mr. Sutcliffe recently made a five weeks' visit to this side of the water, spending much of his time in the study of American theaters. Beginning in New York, the inspection was continued at Philadelphia, Baltimore, Washington, Pittsburg, Cincinnati, Chicago, Cleveland, Buffalo, Boston, and finished in New York again. On his return to England, Mr. Sutcliffe gave his impressions to *The Era*, and has also favored us with the results of his investigations.

"There are certain points," he says, "in which the American theaters differ from the English houses. The ground floor is not divided into pit and stalls, but is given over entirely to stalls. The pit is in some cases called the 'parterre,' and in others the 'orchestra.' The circles are much loftier than in an average English theater, and greater seating accommodation is provided for each person. In the parterre there is usually 36 in. between the back and back of the chairs, whereas in England it is frequently less than 24 in., and in the best houses rarely more than 30 in. The distance from the stalls to the underside of the first balcony varies from 12 ft. to 14 ft., and is the same from the floor of the first balcony to the underside of the second balcony, whereas in most London theaters this distance is between 7 ft. and 9 ft.

VENTILATION OF EMPIRE THEATER, NEW YORK

"The Empire Theater, Broadway, New York, is Mr. Charles Frohman's 'pet' theater. It has a very complete plant for providing its own electric light, and for driving the fans used in ventilating. There are two boilers, each of 60 H. P., but only one is in use, except in the coldest weather. Fresh air is brought down a brick shaft, 6 ft. square from the top of the building to the basement, where a steel plate fan is fixed, which blows this air over steam-heated pipes, and forces it forward into the theater at any desired temperature. The air can also be cooled, and it is distributed under the seats through 4 in. pipes, which have a sort of mushroom cover over them to drive the air back to the floor, and distribute it without draughts.

"The distribution might be made better by having more of these outlets, as there is now only one outlet to every ten seats; but generally the plant seems very effective. The corridors, entrances, dressing-rooms and the stage are warmed by direct steam heat, in radiators fixed against the walls; but they are not connected in any way to the ventilating plant.

"The foul air is extracted from the auditorium at a large number of points in the perforated ceiling by a 6 ft. diameter open type fan or propellor; and in this way a continuous circulation of fresh air is obtained. There is a large steam fire pump always ready for work; but the curtain is only of simple cloth asbestos.

OTHER AMERICAN THEATERS

"The other New York theater, the New Amsterdam, is probably the most artistic in the States. The construction is on very simple and broad lines, two fine balconies and a parterre forming all the seating accommodation, as at the Empire.

"The heating and ventilating is on a mechanical system, warm or cold air being pumped into the theater as required, and the plant here seems very effective. The Philadelphia theaters, the Broad Street, and the Walnut Street, have nothing very different to those already described; and at Baltimore two new theaters, the Maryland and the Auditorium, have only recently been completed. They are back to back, facing on different streets, and adjoin the old Academy Theater, which has the rep-

utation of being second to none in its architectural and acoustic properties.

"Apparently, every theater in the States makes its own electric light; and the Auditorium and the Maryland have a power house for this purpose. The ventilating and heating arrangements are very primitive for new theaters; while the fire resisting curtains are extremely flimsy from an English point of view.

"The new Nixon Theater at Pittsburg is novel, from a constructional point of view. It has a sloping way leading from the back of the stalls to the first balcony, and this is so wide and of such an easy gradient, than an automobile could be easily driven up or down it. The arrangement of the ceiling is also quite different to that of the ordinary theater; as it slopes in a graceful curve from the top of the proscenium opening to the ceiling proper over the balcony.

"As usual, the theater has its own power house, containing two boilers, each of 250 H. P. A very elaborate system of heating and ventilation has been installed, a 9 ft. fan blowing fresh air into a plenum chamber, which runs the length of the theater under the stalls floor. From this chamber air is admitted to the theater proper through open grills or gratings. These would be highly objectionable in an English theater, as the dust and dirt from boots and sweepings could not be kept out, but would drop into the air chamber, and be sent back to the theater in the form of fine dust.

"At the Nixon it is not so objectionable, as no brushes or dusters are used for cleaning, everything being swept and dusted with the vacuum apparatus, which is installed in every part of the theater. The great feature, however, is the 'sloping ways,' so that no steps or stairs are used from the ground floor to the balconies; and this eliminates a great source of danger in case of fire.

"The Studebaker Theater at Chicago has a large number of business offices built over it, extending right over the stage, and one can only imagine what a fire would mean in such circumstances. The height above the proscenium is so limited that the fireproof curtain is taken up in two parts, while the fans for ventilating are fixed in the space between the ceiling of the theater and the floor of the offices above. These fans are intended to blow the air down and distribute it through the building, but it is questionable how far they are effective.

FIRE APPLIANCES IN NEW YORK HIPPODROME

"Returning to New York, I found the Hippodrome had just been opened, and spent a considerable time in examining its construction and appliances. The stage, measuring 50 ft. from the proscenium to the back wall, has many novel and ingenious contrivances, and an 'apron' extends 60 ft. into the theater. On this apron is the circus ring, and under the ring is the aquatic tank. The proscenium opening is 95 ft. wide, and the fire-resisting curtain for this immense width is made of 2 in. gas pipe covered with one thickness of asbestos cloth. The arena, or apron stage, and the main stage stand at the same level when in their normal positions, but the main stage can be raised, by four plungers, 8 ft. above its normal height, and the arena stage can be lowered into the tank any distance up to 14 ft. The pumping machinery furnishing the power for raising the stages is in the basement. The water pressure is 1,000 lbs. per square inch, and the fire line system is connected with the roof tank, while the fire pumps are also connected direct with the aquatic tank, so that there is a reserve supply, for fire purposes, of 400,000 gallons of water; 5,000 ft. of fire hose are placed at various points in the building.

"The supply of water for the sprinklers is taken from a wooden tank, holding 30,000 gallons, fixed on the roof, and the whole of the main stage and the basement are covered with sprinklers. The only objection one can see is that the sprinklers are too high above the stage. They are fixed above the gridiron, which is 93 ft. from the stage level, and it would

have to be a very big fire on the stage that would open a sprinkler over 93 ft. above. Behind the asbestos curtain and about 2 ft. away, a sprinkler pipe is fixed with two rows of heads on it, one to discharge water onto the curtain, and the other to discharge straight down onto the stage, forming, as it were, a wall of water behind the curtain.

"This arrangement is open to the objection that, whereas an asbestos curtain may resist fire heat alone for a considerable time, it will drop to pieces when heat and cold water are combined, and under such circumstances asbestos has been known to crumble at 400 deg., although it has withstood a fire test alone of above 2,000 deg. The seating accommodation is all that can be desired, and the sight lines are very good.

"In American theaters full space is given to each occupant, and far greater attention is paid to the warming, ventilation, and sanitation that is usual here. As regards safety, the Americans have very much to learn from us, and during the whole of the recent visit no fireproof curtains were seen which the London County Council would tolerate for a day."

For Uniform Standards in the Material and Methods Used by Pipe Fitting Trade

President P. Gormly announces the appointment of the following committee to consider and formulate standards for the material and methods in general use by master steam and hot water fitters:

Arthur C. Walworth, chairman, Boston, Mass.

Burton P. Hall, New York city.

E. M. Nichols, Philadelphia, Pa.

The appointment of a committee to undertake this important matter was the result of a resolution passed at the last annual convention of the National Association. The resolution, introduced by Mr. Nichols, of Philadelphia, was as follows:

"Whereas, the lack of uniform standard in the material and methods used by the pipe fitting trade is the cause of the larger part of our contingent losses in the prosecution of work, and realizing that the condition has become intolerable,

"Be it resolved, that the President appoint a committee of three members to consider and formulate standards for the material and methods in general use by the Master Steam and Hot Water Fitters and report their recommendations at the next annual convention, and that no member of said committee is to serve as an official or member of any other committee of this Association."

LACK OF UNIFORMITY IN TAPPING AND THREADING OF CAST IRON FITTINGS

Although the subject has been discussed at previous conventions, to Mr. James Curran, of New York, and to the Boston Local Association belong the credit for initiating the present undertaking, which is one of the most important ever taken up by the Master Fitters' Association.

Mr. Curran's suggestion, which was in the form of a letter to the president, was, in part, as follows:

"I have no doubt that you, like many others in the steam fitting business, have noticed the want of uniformity in the tapping and threading of the cast iron fittings, especially of late years.

"The manufacturers appear to pay very little attention to the standard gauge for tapping or chasing pipe fittings for some years back, and the steam fitting shops have to pay very dearly for their imperfect work.

"We send a man who presumably understands his business, to measure for a long run of large pipe on which there are varions fittings required; he brings his sketch to the machine man, who cuts it as carefully as he can and sends it out. In a short time we get a complaint that the pipe is not cut right, as it don't fit and is not according to measurements; then comes the controversy and the investigation as to who made the mistake, and, as a rule, it is found that one or both openings in some of the elbows are tapped either too large or too small, or off the angle, and the result is that some of

the pipe has to be sent back to the shop or somewhere else to be recut.

"I do not wish to assert that the manufacturer can be held responsible for all our misfit measurements, but I do assert that they are to blame for a very large portion of the waste of labor and material by their apparent carelessness.

"It is common to find a 6-in. or 8-in. elbow with a full thread on a part of it and a half thread on the rest of it. It is also common to find the same size fitting tapped so that a pipe thread will go in six threads on one opening and ten or eleven on the other. You may find a 6-in. or 8-in. cross with a different tapping on each opening. I have found ten or twelve branch manifolds where the pipe would go in from four to seven threads in the same manifold. All this must be charged to the manufacturer and he is directly to blame for it.

"Some years back we had a long controversy in regard to the standard flange, and in that matter the manufacturers agreed to make the change that we required and at quite a large expense to themselves.

"In this, of reaming and threading fittings, we do not ask him to go to any expense in pattern making: we simply ask him to improve his methods of doing the work."

STANDARD WEIGHT OF WROUGHT IRON PIPE.

The Boston Association's suggestion took the form of a resolution, in which it was said, "There is a standard weight for wrought iron and steel pipe, but it is not lived up to by the manufacturers, unless specially specified by the purchaser, and there is no standard of any kind for either valves or fittings."

The committee which was appointed will, therefore, take up both the questions of standard weight for wrought iron and steel pipe and a standard weight and tapping for valves and fittings.

Mr. Nichols, of Philadelphia, in discussing the subject, said, among other things: "Nine-tenths of our contingent losses are because of defective threads and fittings. I had an instance a short time ago of a fitting that was charged to me at 50 cents, which cost me $15.00 before I got it back in place. It is not our boilers, it is not our radiators that cost us so much. When you get threads that are clear up against the shoulder and your men—you can't always trust your own men, they are in a hurry to get through sometimes—what does it mean when you go to test your work?

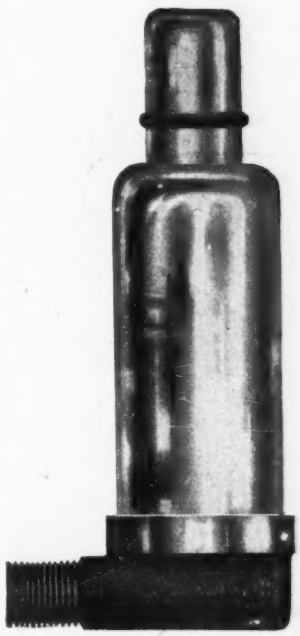
"I do not think that we ought to buy a single article that does not have the manufacturer's trade mark on it. I do not think we ought to even buy a piece of pipe that a manufacturer won't put on in some way some designation so that we will know where it came from."

NEW DEVICES

A New Air Valve

THAT THE AIR VALVE has at last come into its own as a highly-useful adjunct of a successful heating system rather than a necessary evil is evidenced in the perfecting of this small, but important, device that has been going on in recent years.

One of the latest developments along this line is to be seen in an air valve



"AUTAVENT" AIR VALVE

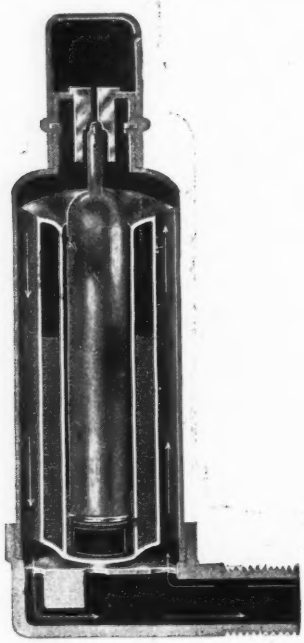
called the "Autavent" recently placed on the market by Pierce, Butler & Pierce Manufacturing Co., Syracuse, N. Y., who, for many years, have given special attention to these appliances.

The "Autavent" is designed both for the perfect venting and controlling steam and hot water heating systems. It is an automatic air expansion syphon air vent made entirely from metal and is of entirely new construction. The air expansion principle is used for the closure of the vent when the system is heated and the flotation of the float when there is a surplus of water.

A float is used to close the outlet from the valve and the air expansion principle for shifting the water contained in the valve so as to bring the float in and out of action. The chamber actuating the float is entirely surrounded by the heating medium, the advantage thereby being that the spitting and hissing prevalent

with over sensitive valves are overcome.

The arrows indicate the part of the valve in communication with the radiating surface. It will be noted that the connection is made at the bottom of the valve, and that its base is constructed with double passages which are especially provided to secure the instant return of surplus water to the radiator and keep these valves free from sediment. Where air valves have the inlet opening near the top such drainage is impossible while they act as a catch basin and are soon filled with sediment and become inoperative. The operation of the valve is as follows: Hot water or steam reaching the air chamber surrounding the float causes the entrapped air to expand and thereby forces the water in the chamber to pass into the space surrounding the float, driving the



SECTIONAL VIEW OF "AUTAVENT" AIR VALVE

latter upward against the valve seat. This seat is of the company's patented "ball joint" type. On the cooling of the radiator, action the reverse of that described takes place, and the float falls, opening the air escape passage. The company also make a vacuum attachment for all valves. This is known as the "Universal." It consists of a circular shell adopted for connecting to the top of any style air valve. This shell contains a flexible sensitive diaphragm. This diaphragm carries at its central point a valve seat similar to that shown in the cross section of the "Autavent" which is normally seated upon the ball joint pin.

Pressure of air in the system raises this diaphragm which in turn raises the seat and opens the passage. When a partial vacuum is created within the heating system, atmospheric pressure above the diaphragm forces the valve seat against the patented ball joint, preventing ingress of air.

This is the first vacuum attachment which has been placed upon the market that is applicable to any style of oat air valve, and which would make a contact air and vacuum valve of any ordinary float valve.

We understand the company is sending samples of these valves to those requesting same.

CLEVELAND STEAM FITTING & SUPPLY CO., Cleveland, Ohio, have the contract for the hot water system in the new residence of Geo. B. McMillan.

J. J. HANIGHEN, Omaha, Neb., has secured the contract for heating the new buildings at Fort Omaha. The contract is worth $16,000.

F. E. KREATZ, St. Cloud, Minn., was awarded the contract for heating and plumbing the Hawthorn and Columbia schools at Little Falls. The contract is in the neighborhood of $5,000.

FINLEY & ROBB, Seattle, Wash., have secured the contract for installing a complete heating and ventilating system in the city school. Their contract price was $3,250.

T. F. PIERPONT, Salt Lake City, Utah, has the contract for the heating and plumbing the Timpanogos school, his bid being $2,866.

F. DESORMOUX & CO., Springfield, Ohio, were awarded the contract for heating the Court House at Wilmington. Their bid was $1,195.

HOME LIGHT, HEAT AND POWER CO., Springfield, Ohio, have secured a five years' contract for heating the county buildings. The contract price is about $1,233 a year.

GRAY & SUTER, Fulton, Mo., have been awarded the contract for installing a heating system at the Court House.

JOHN DRURY, Kankakee, has secured the contract for heating St. Joseph's Seminary, at his bid of $6,500.

BRYCE HEATING CO., Toledo, Ohio, has secured the contract for installing three hot air furnaces in the Waterloo, Ind., school house.

D. W. WALSON & SONS CO., Terre Haute, Ind., has been awarded the contract for the installation of a heating and ventilating system in the Vincennes University buildings.

L. E. POST, Chippewa, Wis., will furnish the heating in the Hotel Royal Op house and some smaller buildings. The contracts will amount to $3,500.

IOWA MFG. CO., Oskaloosa, Ia., was the lowest bidder for heating the public buildings at Kansas City, Mo. Its bid was $15,261.